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# CONSERVATIVE MANAGEMENT STRATEGIES FOR CARPAL TUNNEL SYNDROME: A NARRATIVE REVIEW

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## ABSTRACT

**Introduction:** The most common compressive neuropathy of the upper limb causing pain, paraesthesia and hand dysfunction is carpal tunnel syndrome (CTS). In less advanced stages of the disease, conservative treatment plays a key role as an alternative to surgical treatment or as the first stage of intervention.

**Objective:** The main objective of this review is summarize and properly evaluate current conservative treatment methods for carpal tunnel syndrome and to compare their clinical effectiveness with surgical treatment.

**Methods:** A review of the scientific literature was conducted using the PubMed and ScienceDirect databases for studies published between 2015 and 2024. Review articles, clinical studies and meta-analyses on non-surgical treatment, including immobilisation, physiotherapy, pharmacotherapy and corticosteroid injections, were included.

**Results:** Wrist immobilisation, physiotherapy, pharmacological treatment and corticosteroid injections are the most commonly used conservative methods. In patients with mild or moderate forms of the disease, these methods can significantly reduce symptoms and improve hand function. However, depending on the stage of the disease, the duration of symptoms and comorbidities, their effectiveness varies

**Conclusions:** Conservative treatment is an effective and less invasive option for patients with mild to moderate carpal tunnel syndrome. Individualised therapy based on the severity of clinical symptoms and patient needs, which is in line with current guidelines, achieves the best results.

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## KEYWORDS

Carpal Tunnel Syndrome, Conservative Treatment, Splinting, Physiotherapy, Pharmacotherapy, Corticosteroid Injections

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## 1. Introduction

Carpal tunnel syndrome (CTS) is the most common entrapment neuropathy of the upper limb, caused by compression of the median nerve within the carpal tunnel. Its prevalence is 3–6% of the general population, but the condition most commonly affects women of working age [1–3]. Pain, numbness and paraesthesia in the area innervated by the median nerve are the most characteristic symptoms, which often worsen at night and lead to impaired manual dexterity. Significant socio-economic burdens, including reduced work productivity, sick leave and increased healthcare costs, are particularly associated with CTS [2,4].

The severity and duration of symptoms, as well as the presence of comorbidities and patient preferences, largely determine the choice of treatment [5–8]. In advanced or treatment-resistant cases, the method of choice is surgical decompression of the carpal tunnel, providing long-term symptom relief and functional improvement [5,13,15]. In patients with mild to moderate disease, where pathological changes are potentially reversible and surgery can often be avoided or delayed, conservative treatment plays a crucial role [1,3,7,8]. Wrist immobilisation, physiotherapy, pharmacotherapy and corticosteroid injections are the most commonly used conservative treatment methods, which aim to reduce pressure inside the wrist, alleviate symptoms and improve hand function [3,6,8].

In the carpal tunnel syndrome, there is no universally accepted algorithm for conservative treatment, despite the wide range of available treatment methods. The severity of the disease, the physician's experience and the patient's expectations form the basis for clinical decision-making. In addition, the scientific literature is heterogeneous, and studies vary considerably in terms of design, patient population and measured outcomes, making direct comparisons difficult and hindering the development of clear evidence-based recommendations. In this case, it is necessary to summarise the current knowledge on conservative treatment strategies.

## 2. Methods

To identify studies on conservative treatment of carpal tunnel syndrome (CTS), a literature review covering the period from January 2015 to December 2024 was conducted. Relevant publications were searched for in the PubMed and ScienceDirect databases. The search strategy included keywords and MeSH terms such as “carpal tunnel syndrome,” “conservative treatment,” “splinting,” “physiotherapy,” “pharmacotherapy,” and “corticosteroid injections,” combined using Boolean operators. Review articles, clinical studies, and meta-analyses addressing non-surgical management of CTS were included. Case reports, conference abstracts, and articles not published in English were excluded. The selection of articles was based on relevance to the topic, and final inclusion was determined by consensus among the authors.

## 3. Results

### 3.1 Splinting and Immobilization

One of the most commonly used conservative treatments for carpal tunnel syndrome is immobilisation of the wrist using splints, especially those worn at night [1,3,8–11]. Regular use of splints can lead to a reduction in symptoms, especially night-time paraesthesia, and in some cases may delay or even eliminate the need for surgical intervention [8–10]. It is recommended to use splints for 4–6 weeks, mainly at night, when symptoms are usually most severe. Consistent use and proper fitting of the splint are responsible for the effectiveness of this intervention. This therapy is an appropriate first-line option for patients with mild to moderate disease, as it is inexpensive, safe and well tolerated [1,8,9].

According to studies comparing different types of splints, the most effective ones are those that keep the wrist in a neutral position — without excessive flexion or extension [8–10]. Rigid splints may be less comfortable but provide better joint stabilisation, while soft splints are generally more comfortable but provide less relief for the median nerve [9,11]. Wearing splints both day and night may lead to faster symptom relief, although these differences are not always clinically significant, as confirmed by some analyses [8,10]. In choosing a splint, the severity of symptoms should be taken into account and the patient's preferences should be considered. Splints remain a simple, well-documented and effective conservative treatment for patients in the early stages of carpal tunnel syndrome, despite differences in design [8–11].

**Table 1.** Comparison of different types of orthoses used in the conservative treatment of carpal tunnel syndrome

Type of orthosis	Wrist position	Main advantages	Main disadvantages	Effectiveness
Rigid night splint	Neutral	Good stabilization; reduces nocturnal symptoms [8–10]	Less comfortable, more difficult adaptation	High effectiveness with regular use [8–10]
Soft night splint	Neutral or slightly extended	More comfortable; better tolerance [9,11]	Less median nerve decompression	Moderate, depends on design [9,11]
Full-time (night + day)	Neutral or slightly extended	May provide faster symptom improvement [8,10]	May limit hand function during the day; lower patient acceptance	Similar or slightly higher than night-only use [8,10]

Source: Authors' own work based on [8–11].

### 3.2 Physiotherapy and Adjunctive Methods

Physiotherapy is an important part of conservative treatment for carpal tunnel syndrome. Various techniques are used in clinical practice to reduce pressure on the median nerve, improve nerve mobility and alleviate symptoms [3,9,10,20]. The most commonly used interventions include median nerve gliding exercises, therapeutic ultrasound, low-intensity laser therapy, manual and neurodynamic techniques, and extracorporeal shock wave therapy (ESWT) [9,10,20]. These methods can be used as a standalone treatment or in combination with other methods, such as immobilisation or corticosteroid injections. Patient preference, equipment availability and therapist experience are key factors in the choice of technique. In the early stages of the disease, when pathological changes are still reversible and symptoms do not yet require surgical intervention, their use is particularly important [3,9,20].

Studies have demonstrated that exercises stretching the median nerve may lead to moderate improvement in symptoms and hand function, especially in mild cases of carpal tunnel syndrome [20]. The evidence is inconclusive, but therapeutic ultrasound may help reduce swelling and inflammation within the carpal tunnel [9,10]. Low-power laser therapy and manual techniques have also been shown to have a beneficial effect on reducing symptoms, although the quality and quantity of evidence for this is limited [9,18]. Extracorporeal shock wave therapy, which may provide short-term improvement in symptoms, is gaining interest, but further research is needed to confirm its effectiveness [9]. Overall, physiotherapy methods are safe and well tolerated, and are most effective when incorporated into a comprehensive conservative treatment strategy [3,9,20].

**Table 2.** Overview of physiotherapeutic methods used in the conservative treatment of carpal tunnel syndrome

Method	Advantages	Limitations	Effectiveness According to Studies
Nerve and tendon gliding	Improve nerve mobility; simple to perform at home	Require patient compliance; variable response	Positive outcomes in mild CTS [3,9,20]
Manual therapy	Non-invasive; may improve carpal tunnel flexibility	Requires trained therapist; effectiveness depends on technique	Mixed evidence [9,10,20]
Ultrasound therapy	Reduces inflammation and edema; painless	Effect depends on parameters and equipment availability	Moderate effectiveness [9,20]
Laser therapy	Non-invasive; may reduce pain and inflammation	Results vary; limited evidence	Mixed to moderate [9,20]
Shockwave therapy (ESWT)	Potential for symptom reduction, non-invasive	Few studies; optimal parameters not established	Preliminary evidence [20]

Source: Authors' own work based on [3,9,10,20].

### 3.3 Pharmacotherapy and Corticosteroid Injections

Pharmacological treatment of carpal tunnel syndrome is primarily symptomatic and usually complements other therapeutic methods. The most commonly used drugs are non-steroidal anti-inflammatory drugs (NSAIDs), which aim to relieve pain and reduce inflammation [3,9]. Although NSAIDs can provide short-term relief of symptoms, scientific evidence supporting their effectiveness in improving long-term median nerve function is limited [3]. Analgesics and anti-inflammatory drugs do not address the underlying mechanical causes of the condition and are therefore not recommended as stand-alone treatments [9]. However, their use may be beneficial in patients in the early stages of the disease or as part of a broader conservative treatment plan [3,9].

For patients with mild or moderate disease, or as bridging therapy prior to possible surgical intervention, corticosteroid injections are a significant conservative treatment option [17–19]. Glucocorticosteroids reduce inflammation and swelling in the carpal tunnel, leading to temporary improvement of symptoms [17,18]. According to meta-analyses, corticosteroid injections were more effective than placebo and splinting in short-term treatments (up to three months), but their effect is not permanent [17,18]. To minimise complications and potentially prolong the therapeutic effect, ultrasound-guided injections are increasingly being used to increase the precision of the procedure [19]. Despite short-term effectiveness, many patients, especially those with severe or long-lasting symptoms, ultimately require surgical treatment [13,17].

**Table 3.** Pharmacological and injection treatments for carpal tunnel syndrome – advantages, limitations, and effectiveness

Method	Advantages	Limitations	Effectiveness According to Studies
NSAIDs	Widely available; low cost; mild pain relief	Limited efficacy; gastrointestinal side effects; no impact on nerve compression	Mixed evidence [3,9,13,17–19]
Corticosteroid injections	Rapid symptom relief; effective short- to mid-term	Possible recurrence; requires trained personnel; risk of complications	Strong short-term evidence [3,9,13,17–19]

*Source: Authors' own work based on [3,9,13,17–19].*

### 3.4 Conservative Versus Surgical Treatment

Surgical treatment of carpal tunnel syndrome, involving decompression of the carpal tunnel, is considered the most effective method of achieving lasting relief in cases of median nerve compression [5,12,13,15]. Surgery leads to significant long-term improvement in symptoms and hand function, with a relatively low recurrence rate, as demonstrated by numerous systematic reviews and meta-analyses [5,13,15]. Conservative treatment, including immobilisation, physiotherapy and corticosteroid injections, usually provides temporary benefits by alleviating symptoms in patients with mild to moderate disease [3,8,9]. Therefore, surgery is reserved for severe, chronic or treatment-resistant cases, and conservative therapy is usually the first-line treatment [5,13].

In clinical practice, a stepwise strategy is often used: conservative therapy lasting 4 to 12 weeks is initiated, followed by an assessment of the treatment's effectiveness [5,13]. Patients who show satisfactory improvement in symptoms continue non-surgical treatment, while surgical intervention is considered for patients with persistent or worsening symptoms. The severity of symptoms, electrodiagnostic test results and patient preferences are important factors in the decision to proceed with surgical procedures [5,12]. This approach avoids unnecessary surgery in some patients while ensuring timely and effective treatment for those with advanced disease [13,15].

**Table 4.** Comparison of conservative and surgical treatment of carpal tunnel syndrome

Feature	Conservative Treatment	Surgical Treatment
Effectiveness and duration	Good effectiveness in mild/moderate cases; effect often temporary [3,8,9]	High long-term effectiveness; low recurrence rate [5,12,13,15]
Advantages	Non-invasive; well tolerated; may avoid surgery	Rapid and durable symptom relief
Limitations	Requires regular use and monitoring; effects may be temporary	Surgical risks; recovery time
Clinical practice	First-line in mild/moderate disease [3,8]	Severe, chronic, or treatment-resistant cases [5,13]
Rationale	Stepwise; less invasive approach	Definitive treatment for advanced disease

Source: Authors' own work based on [3,5,8,9,12,13,15].

### 3.5 Clinical Guidelines and Recommendations

Depending on the severity of symptoms, duration and presence of comorbidities, there is a need for an individual approach to the treatment of carpal tunnel syndrome, as emphasised by current guidelines from orthopaedic and neurological associations [8,13,17]. Conservative treatment, including immobilisation, physiotherapy or corticosteroid injections, is recommended for most patients with mild to moderate symptoms [8,9,17]. Surgical intervention should be considered if no significant improvement is achieved after the typical duration of conservative treatment, which is 4 to 12 weeks [5,13]. Surgery is the recommended first-line treatment for patients with severe clinical symptoms or advanced electrodiagnostic changes [5,13].

Educating patients on risk factor modification and the proper use of recommended therapeutic methods is an important part of effective treatment [8,17]. The guidelines emphasise that appropriately selected and consistently applied conservative methods can significantly improve clinical outcomes and reduce the number of unnecessary surgical procedures [8,13,17].

## 4. Discussion

Carpal tunnel syndrome (CTS) remains one of the most common entrapment neuropathies of the upper limb, and its prevalence in the general population continues to increase, particularly among working-age adults [1–3]. The pain, paraesthesia and hand dysfunction associated with this condition significantly affect patients' ability to work and their overall quality of life. Therefore, choosing the right treatment has clinical and socio-economic consequences. In mild and moderate cases, conservative therapy plays a particularly important role, as it alleviates symptoms, improves hand function and may delay or even avoid the need for surgery [1–4,6,8].

Immobilisation of the wrist, physiotherapy and corticosteroid injections are the most commonly used conservative treatments. Pain reduction, improvement in neurological and functional parameters, as well as improvement in patients' quality of life are possible with properly selected non-surgical care [2–4,6,8]. However, many factors influence the effectiveness of individual methods. These include the severity of the disease, the duration of symptoms, comorbidities, and patient compliance [5,7,8]. The availability of specific therapies and the experience of the therapeutic team are also of paramount importance in clinical practice.

Wrist immobilisation is a simple, safe and effective strategy, especially in the early stages of CTS, as indicated by comparative analyses of conservative approaches [1,3,9,10]. Night splints, when used regularly, significantly reduce pressure on the median nerve and alleviate nocturnal paraesthesia, improving sleep quality and patient comfort. In the long term, physiotherapy, including nerve relaxation exercises, soft tissue mobilisation and various physical methods, has shown good functional results [2,3,16,20]. Notably, neuromobilization techniques may reduce symptoms by improving nerve excursion and decreasing mechanical irritation [16,20]. In the case of corticosteroid injections, the benefits are often short-lived and recurrence rates remain relatively high within a few months; however, they provide rapid relief of symptoms due to their anti-inflammatory effect [17–19]. According to numerous studies, combining different methods, such as immobilisation with a splint and physiotherapy or injections, yields better results than using a single method [9,12].

The severity of the disease, the duration of symptoms, the response to previous interventions, and the patient's preferences determine the final choice between conservative and surgical treatment. Surgical decompression usually leads to faster and more lasting clinical improvement in cases where conservative therapy has not produced the expected results or the condition is at an advanced stage [5,8,13,15]. Nevertheless,

in elderly patients, those with comorbidities or those who prefer less invasive treatment methods with mild or moderate CTS, non-surgical treatment remains a valuable option. [8,12,13,15]. Making timely decisions regarding possible surgical intervention enables appropriate patient selection and regular monitoring of treatment outcomes.

However, existing studies on conservative treatment of CTS have several limitations. It is difficult to compare and develop clear recommendations, as many of them involve small samples, short observation periods and considerable methodological heterogeneity [3–5,7]. Differences in inclusion criteria and outcome measures, as well as methodological issues such as lack of randomization, insufficient control of confounders, and lack of blinding, increase the risk of bias. For some techniques, such as platelet-rich plasma (PRP) injections or advanced neuromobilization methods, the number of high-quality studies remains limited [9,16,20]. Moreover, the effectiveness of combined strategies and long-term results has not been adequately assessed. These limitations highlight the need for further well-designed clinical trials with larger sample sizes and standardized outcome measures.

From a practical standpoint, treatment of carpal tunnel syndrome should be individualized, taking into account the severity of the condition, risk factors and patient preferences. In mild cases, splinting should be the first choice due to its simplicity, low cost and proven short-term effectiveness [1,3,9,10]. However, physiotherapy is a valuable addition to treatment, leading to improved hand function and quality of life [2,3,16,20]. Corticosteroid injections can be useful in moderate CTS when rapid symptom relief is required, though their long-term effectiveness remains limited [17–19]. Combining the expertise of orthopaedic surgeons, neurologists and physiotherapists with the active involvement of patients, known as the interdisciplinary approach, improves treatment outcomes and reduces the frequency of recurrence.

## 5. Conclusions

Conservative treatment plays a key role in managing mild and moderate carpal tunnel syndrome, often providing effective symptom relief and functional improvement without surgery. The most commonly used methods—wrist splinting, physiotherapy, and corticosteroid injections—show proven clinical benefits, though outcomes depend on disease severity, symptom duration, and patient factors. The current data show gaps in long-term outcomes and a lack of standard protocols, but individual treatment strategies can increase the effectiveness of therapy. Interdisciplinary collaboration with active patient involvement is essential for optimising outcomes and reducing recurrence, but further well-designed studies are needed.

## Disclosure

### Author Contributions

Conceptualization: Wiktoria Auguścik

Methodology: Katarzyna Bielawska

Formal analysis: Wiktoria Auguścik, Aleksandra, Katarzyna Bielawska

Validation: Wiktoria Auguścik, Katarzyna Bielawska

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Writing -rough preparation: Katarzyna Bielawska

Writing -review and editing: Katarzyna Bielawska, Aleksandra

Visualization: Aleksandra

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