Review paper

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The use of orthoses in the treatment of carpal tunnel syndrome. A review of the literature from the last 10 years

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Abstract

Introduction: A review of the literature from the last 10 years quite clearly shows that immobilization of the wrist in the splint (orthosis) is the most effective, initial method of conservative treatment of carpal tunnel syndrome (CTS). The particular advantages of the described method of treatment are: availability, low cost, good patient tolerance, simplicity and minimal incidence of complications.

The aim of this study was to try to define the criteria of proceeding with the selection of the type of orthosis and the duration of its use depending on the clinical condition and the patient's expectations.

Methods: The PubMed electronic database was searched for appropriately selected studies published between 2012 and 2022. The search strategy used was based on the following keywords: carpal tunnel syndrome, immobilization, orthosis, conservative treatment. The authors also searched the cited literature on relevant research and review papers on potentially relevant topics related to conservative treatment of the CTS.

Conclusions: Immobilization in an orthosis gives therapeutic effects in all patients, regardless of the stage of the carpal tunnel syndrome.

Most often the orthosis is only used at night for several weeks. During the exacerbation of symptoms, it can also be used during the day during activities that increase symptoms.

In practice, it is recommended to wear a splint that immobilizes the wrist in a neutral position or slightly extended at 0–15 degrees (most often 0–5 degrees).

A splint immobilizing the wrist and the 2–5 metacarpophalangeal joints are recommended for patients with positive Berger test results.

There are no statistically significant differences in the treatment results between individual and traditional orthoses.

No statistically significant differences were observed in the treatment effects between rigid and soft orthoses.

Key words: carpal tunnel syndrome, conservative treatment, splint, orthosis.

Introduction

A review of the literature from the last 10 years quite clearly shows that immobilization of the wrist in the splint (orthosis) is the most effective, initial method of conservative treatment of carpal tunnel syndrome (CTS). The specific advantages of the described method of treatment include: availability, low cost, good patient tolerance, simplicity and a negligible number of complications [1–5]. The American Academy of Orthopedic Surgeons (AAOS) guidelines on CTS suggest that there is strong evidence to support the use of splint (orthosis) fixation to improve

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patient-reported outcomes [6]. Many studies show that the use of splints can reduce the intensity of symptoms within just a few weeks of treatment [7].

There is a discussion in the literature about the optimal way to immobilize the wrist. There are still many questions about the details related to certain details in the construction and function of orthoses: angle of wrist immobilization, nature of the orthosis (palmar/dorsal), period of application, method of implementation (traditional/individual).

The aim of the following study was to present various ways of immobilizing the wrist in the orthosis depending on the patient's clinical condition and expectations. The following aspects were taken into account in the analysis: CTS grade, the period of use (during the day/night), the angle of immobilization, the nature of the orthosis (palm/dorsal, traditional/individual, rigid/soft).

Methods

Systematic searches of PubMed were conducted to identify the studies published between 2012 and 2022. The search strategy used was based on the following key words: carpal tunnel syndrome, immobilization, orthosis, conservative treatment. Participants were adults with a diagnosis of CTS.

A PubMed search identified 203 articles for review. After applying exclusion criteria, 25 articles were included for analysis. In this systematic review and meta-analysis, no limitation criteria were used for study selection. Relevant journals or conference proceedings were searched manually to identify studies that might have been missed in the database search. The authors also searched the cited literature on relevant studies and review papers on potentially relevant studies related to conservative treatment of CTS.

Results

Carpal tunnel syndrome grade and treatment results

The literature review shows that the choice of treatment method in patients with CTS should be based on the duration of symptoms and their intensity.

Nerve Conduction Study (NCS) is the only objective way to localize compression in the upper limb, quantify the degree of nerve dysfunction and the progression of changes, and is therefore considered the gold standard. It enables confirmation of the diagnosis and objective assessment of the degree of nerve damage [8, 9].

The electrophysiological classification, in agreement with the American Association of Electrodiagnostic Medicine (AAEM) guidelines, follows the neurophysiological progression of CTS severity and includes the following classes [10]:

1 – negative: normal findings on all tests (including comparative and segmental studies),
2 – minimal: abnormal findings only on comparative or segmental tests,
3 – mild: sensory nerve conduction velocity (SCV) slowed in the finger-wrist tract with normal distal motor latency (DML),
4 – moderate: SCV slowed in the finger-wrist tract with increased DML,
5 – severe: absence of sensory response in the finger-wrist tract with increased DML,
6 – extreme: absence of thenar motor response.

In the case of mild and moderate severity of the syndrome, it is recommended to attempt conservative treatment (which includes immobilization of the wrist in an orthosis) before deciding on surgery. Most studies show good results of conservative treatment in patients with mild and moderate CTS [1].

Studies by Šošić et al. [6] show that the use of the immobilizing scales at night has beneficial effects not only in patients with mild, but also with severe CTS. Therefore, this method of therapy is recommended for all patients, regardless of the stage of the syndrome [6]. This may be important information, especially in the case of patients qualified for surgery and awaiting surgery.

Use of the orthosis during the day/night

As a rule, the orthosis is only used at night for several weeks [1, 6, 11–13]. In the period of exacerbation of symptoms, it is advisable to use it also during the day during everyday activity [1, 7]. Similarly, Weng et al. [5] believe that wrist immobilization is an effective method of treatment, especially when it is also used during the day. Farahmand et al. [14] suggest wearing the orthosis at night, and during the day only when the patients so wish. Halac et al. [15] report that the use of the immobilizing splint at night may be an effective treatment method, but in patients with symptoms that occur only at night.

In patients with persistent symptoms that also occur during the day, it is necessary to use an additional form of therapy in the conservative treatment of CTS. According to Walker et al. [16] the use of splints part-time (at night) had a more positive effect on functional activities than the use of splints full-time. The full-time use of splints is often not preferred by patients [14]. Cochrane confirmed that night immobilization is more effective than placebo, but the authors did not find a specific orthosis model that gave the best treatment results [3].

The angle of immobilization of the wrist

The therapeutic effect of using orthoses is associated with preventing the adoption of extreme positions in the wrist, which translates into lowering the pressure in the wrist canal. It has been shown that resting intra-canal pressure in patients with CTS is elevated, and wrist positions that are further away from the neutral position may increase it. Wearing wrist splints in a neutral position or a slight extension of 0–15 degrees (most often 0–5 degrees) can increase the carpal tunnel space, reduce pressure on the median nerve, and thus alleviate symptoms. Moreover, the neutral position improves hemodynamic parameters [1, 2, 4, 6, 12, 14, 15, 17, 18].

According to Farahmandl et al. [14] the angle of wrist immobilization differs between different orthosis designs. In their experience, some doctors prescribe splints without paying attention to the angle of the wrist; which can lead to disappointment in patients with the results of the treatment. This may be due to the fact that some of the orthoses in use keep the wrist near a functional angle (more than 20 extensions), which appears to increase the pressure in the wrist canal [14]. Wipperman and Goerl [3] report that patients who use wrist immobilization in the neutral position were twice as likely to report an improvement in symptoms compared to the straightened wrist position. Sprouce et al. [4] report that the optimal restraining position is still debatable with limited evidence for a neutral position.

Individually made orthoses/prefabricated (traditional) orthoses

Available publications suggest that there are no statistically significant differences in treatment results in both groups of orthoses. Malakar et al. [17] compared the effectiveness of traditional and custom-made orthoses. The obtained results showed no differences between people using prefabricated orthoses with the wrist placed in the wrist extension position at an angle of 20°, and those made individually to order with a neutral wrist position [17]. Figueiredo et al. [19] confirmed the presence of clinical improvement in both groups of orthoses. A greater degree of improvement was observed in the group treated with individually made scales; however, the observed differences were statistically insignificant.

Individually custom-made wrist braces are more expensive than ready-made ones, and so far have taken a long time to make. 3D printer technology can overcome these problems, making it possible to produce personalized medical products at low costs, with a shorter production time compared to the production methods used so far (thermoplastic orthoses are still used today) [2].

The use of prefabricated splints should always be combined with an accurate measurement of the forearm and/or hand for a better fit. Moreover, when putting on the wrist orthosis, it should be checked whether the fastening straps are fastened too tightly, leading to the intensification of paresthesia or impaired mobility of the fingers caused by blood flow disorders [7].

Palmar/dorsal splint

The vast majority of orthoses used in the treatment of CTS are palm splints. The only study comparing the effectiveness of the treatment of both types of splints was conducted by Farahmandl et al. [14] A splint with a dorsal block positioned the wrist in the neutral position (0–5°), the MCP joints were in the 0–10° position of flexion, and the proximal interphalangeal (PIP) had flexion of 20–30°. The DIP joints (1–5) and the MCP joint of the thumb remained free from immobilization. The palmar splint covered only the wrist in the neutral position (0–5°) and ended just before the MCP. Thus, the MCP and PIP were free from movement restrictions. Non-elastic Velcro fasteners are used in the splint to increase the efficiency of the splint and reduce the relative movement of the hand and wrist.

Farahmandl et al. [14] claim that the use of a dorsal orthosis as compared to the palmar splints may give better treatment results.

Immobilization of the wrist only/ immobilization of the wrist and metacarpophalangeal joints

As a rule, most splints do not extend beyond the distal flexion line of the wrist. The advantage of such a splint is that the fingers can move freely, thus allowing the normal performance of everyday activities.

In some orthoses, the aim is to immobilize the metacarpophalangeal joints of fingers 2–5. According to the authors, this prevents retraction of the lumbrical muscles proximally thus theoretically reducing the pressure in the carpal tunnel [1].

Lewis et al. [11] suggest that the decision on the type of orthosis to be used may depend on the result of the Berger test, also found in the literature as the lumbrical provocation test. This test is performed to determine whether the displacement of the lumbrical muscles into the carpal tunnel affects the severity of the characteristic symptoms of CTS. It consists in actively performing the maximum flexion of the fingers (with the wrist set in the neutral position) and maintaining this position for a period of 30 seconds [4] or 60

seconds [20, 21]. The test result is positive if symptoms appear or worsen in the area innervated by the median nerve during this time [11, 20, 21].

If the Berger test is negative, the use of a neoprene orthosis with individually molded thermoplastic braces, which keep the wrist in a neutral position without immobilizing the MCP joints, is recommended.

People with a positive result of the Berger test receive an orthosis, which also keeps the wrist in a neutral position, but it is additionally extended, reaching distally to the level of the proximal phalanges (and thus limiting the possibility of bending the metacarpophalangeal joints 2–5) [11].

Rigid orthosis/soft orthosis

A comparison of the treatment efficacy using a rigid and soft orthosis made by Ostergaard et al. [22] showed no statistically significant differences between the two types of orthoses. This suggests that the choice of the type of orthosis may depend on the patient's preferences and the experience of the therapist.

Other aspects of the use of wrist orthoses

Although the use of splints is a simple and safe procedure, it has some drawbacks. Some patients say that, after all, wearing even the best-fitting orthosis is uncomfortable and limits the ability to perform some professional and everyday activities.

The need to discontinue treatment due to skin irritation or orthosis intolerance is reported by less than 1% of patients [1, 6, 22–27]. Due to the above, the use of kinesiotaping may be an alternative method of CTS treatment, the effects of which are similar to immobilization in an orthosis. The advantage of this form of therapy is that it does not limit the functional capabilities of the hand [18]. Studies by Yeong-Dong et al. [28] showed that the use of taping improved the electrophysiological parameters of the median nerve by reducing the pressure in the carpal tunnel. Therefore, the technique used can be treated as an early prophylactic method in patients with mild CTS [28].

Some authors, for example Lewis et al. [11], suggest that immobilization in an orthosis should be combined with patient education and home exercises (flexor tendon sliding exercises) [11, 12]. Similarly, Weng et al. [5] recommended wearing an orthosis while sleeping, and additionally instructed patients to avoid bending their wrists during everyday activities such as washing clothes, cycling, working at the computer, and carrying heavy shopping bags.

Kaplan et al. [13] confirmed that the addition of kinesiotaping to the night use of the orthosis was more effective in achieving improvement than the orthosis alone or the additional use of paraffin in patients with mild and moderate CTS. Howell et al. [7] report that immobilization in an orthosis may be combined with physiotherapeutic procedures in order to obtain even better treatment results.

Conclusions

Stage of CTS: immobilization in an orthosis gives therapeutic effects in all patients, regardless of the stage of the syndrome, although the vast majority of authors recommend it in patients with mild and moderate CTS. In patients with severe CTS (with NCS changes in the motor fibers of the median nerve), it can be used in patients qualified for surgical treatment awaiting surgery.

Day or night use: As a rule, the orthosis is only used at night for several weeks. During the exacerbation of symptoms, it can also be used during the day during activities that increase symptoms. One alternative is to combine overnight immobilization in an orthosis with educating the patient to avoid movements that aggravate symptoms during the day.

Immobilization angle: in practice, it is recommended to wear a wrist splint in a neutral position or a slight extension of 0–15 degrees (most often 0–5 degrees). Avoid using orthoses that keep the wrist near a functional angle (more than 20 extensions), which may increase the pressure in the wrist canal.

Individual or prefabricated (traditional): there are no statistically significant differences in the results of treatment in both groups of orthoses. In practice, traditional orthoses are used more often (they are more accessible and cheaper). When choosing, one should remember about their exact matching. If there is no such possibility, it is worth considering making a personalized shell, which is becoming more and more common due to the development of 3D printer technology.

Palmar or dorsal: the vast majority of orthoses used in the treatment of CTS are palmar orthoses. This orthosis model gives you more options in terms of daily activity.

With or without MCP: as a rule, most splints do not extend beyond the distal flexion line of the wrist. Splints immobilizing the wrist and the 2–5 metacarpophalangeal joints are recommended for patients with a positive result of the Berger test, also found in the literature as the lumbrical provocation test.

Rigid/soft orthosis: The choice of the type of orthosis depends on the patient's preferences and the expe-

rience of the therapist. No statistically significant differences were found in the treatment effects between the two types of orthoses.

The authors declare no conflict of interest.

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