Surgical treatment for Bell's palsy – review

Leczenie chirurgiczne w porażeniu Bella – przegląd piśmiennictwa

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KEYWORDS:

- facial nerve decompression
- Bell's palsy

ABSTRACT

Introduction: Bell's palsy is a peripheral, unilateral facial nerve palsy of sudden onset and an unknown cause. The diagnosis is primarily based on clinical examination, but in some patients performing electrophysiological tests, i.e., electroneurography (ENoG) and electromyography (EMG), can be recommended for prognostic purposes. Glucocorticoids are the mainstay of treatment in Bell's palsy, whereas surgical treatment remains controversial.

Objectives and methods: Review of literature concerning the relevance of facial nerve decompression for Bell's palsy, its techniques and efficacy, as well as patient's eligibility criteria for surgical treatment. Only publications in English were included.

Results: The assumption that facial nerve in this entity becomes compressed in the narrowest portion of the facial canal, i.e., meatal foramen, can be the rationale for facial nerve decompression in this segment. The optimal surgical exposure of this portion of the facial canal is provided by middle cranial fossa approach, although the efficacy of facial nerve decompression via transmastoid approach has also been reported. Most surgeons consider the degeneration of >90% of facial nerve fibers shown in ENoG the eligibility criterion for surgical treatment in Bell's palsy. There is no consensus on when facial nerve decompression after the onset of Bell's palsy should be performed.

Conclusion: Observations show that facial nerve decompression should be considered, if a patient fulfills clinical and electrophysiological criteria. As long as high level quality evidence lacks, clinicians' attitude towards surgical treatment for Bell's palsy will remain ambivalent.

SŁOWA KLUCZOWE:

- dekompresja nerwu twarzowego
- porażenie Bella

STRESZCZENIE

Wstęp: Niedowładem Bella określa się obwodowy, jednostronny niedowład nerwu twarzowego o nagłym początku i nieznanej przyczynie. Rozpoznanie na ogół opiera się na wywiadzie i objawach klinicznych, jednak w celach prognostycznych u niektórych pacjentów zaleca się poszerzenie diagnostyki o badania elektrofizjologiczne: elektroneurografię (ENoG) i elektromiografię (EMG). Spośród metod leczenia zachowawczego w porażeniu Bella główną rolę odgrywają glikokortykosteroidy, natomiast leczenie chirurgiczne pozostaje sprawą kontrowersyjną.

Cele i metody: Przegląd piśmiennictwa w temacie zasadności, technik, czasu i skuteczności podejmowanego leczenia chirurgicznego w porażeniu Bella oraz kryteriów do niego kwalifikujących. Przeanalizowano tylko publikacje anglojęzyczne.

Wyniki: Uzasadnieniem dekompresji nerwu twarzowego może być założenie, że nerw twarzowy w tym schorzeniu ulega uciśnięciu w kanale nerwu twarzowego w kości skroniowej, w obrębie jego najwęższego odcinka, tzw. meatal foramen. Optymalne uwidocznienie tego fragmentu kanału nerwu twarzowego uzyskuje się dostępem przez środkowy dół czaszki, jednak istnieją doniesienia o skuteczności dostępu transmastoidalnego. Większość badaczy decyzję o kwalifikacji pacjenta z porażeniem Bella do leczenia chirurgicznego opiera na kryterium >90% degeneracji włókien nerwowych wykazanej w badaniu ENoG. Nie ma zgody, w jakim czasie od początku objawów porażenia Bella powinno się podejmować dekompresję nerwu twarzowego.

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Wnioski: Wydaje się, że dekompresja nerwu twarzowego powinna być rozważona, gdy pacjent spełnia kryteria kliniczne i elektrofizjologiczne. Dopóki nie pojawią się dowody naukowe o wysokim stopniu rzetelności, dopóty postawa klinicystów wobec leczenia chirurgicznego w porażeniu Bella pozostanie ambiwalentna.

Introduction

Facial nerve is a cranial nerve, which leaves the brainstem in the cerebellopontine angle, then passes through the internal auditory canal to its canal in the temporal bone, which facial nerve leaves through the stylomastoid foramen to reach the external surface of the skull base. Bell's palsy is a peripheral, unilateral facial nerve palsy of sudden onset and an unknown cause. The entity is manifested by limited function of mimic muscles on half of the face. Reported incidence rates for Bell's palsy vary from 8 per 100,000 (1) to 240 per 100,000 (2). Most studies have yielded results incidence rates of 17 to 35 (3, 4, 5, 6). The degree of palsy can be assessed with different grading scales, among which the six-grade House-Brackmann Grading System (HBGS I-VI) is the most commonly used. In 71-85% of patients total spontaneous return of facial muscles function is expected within a year after the onset of symptoms without introducing any form of treatment (6, 7, 8). The prognosis of recovery depends on the distinction, whether in a particular case paresis, i.e., partial dysfunction, or paralysis, i.e., total dysfunction, has occurred. Patients with paralysis are burdened with a worse prognosis as to total or at least satisfactory recovery (HBGS II), which was pointed out by Linder (9) and, thus, can be considered for other forms of treatment, i.e., surgery. The number of cases of paralysis among patients with Bell's palsy is around 30% (6, 10). In these patients performing electrophysiological tests, i.e., electroneurography (ENoG) and electromyography (EMG), is recommended for prognostic purposes. The aim of ENoG is to estimate the percentage of facial nerve fibers, which have undergone degeneration, based on the difference in the amplitude of the action potential of mimic muscles contra- and ipsilateral to the affected side after administering a suprathreshold electric stimulus. The result >90% is a negative prognostic factor for satisfactory recovery in Bell's palsy (11). In EMG, on the other hand, by means of needle electrodes voluntary response of mimic muscles is assessed. The presence of such a response suggests incomplete degeneration of facial nerve fibers, whereas the absence of such a response, with detected in ENoG >90% degeneration, confirms a significant degree of facial nerve fibers degeneration. Adour et al. (12) emphasized, though, that the above-mentioned electrophysiological tests have their limitations, e.g., artifacts from the masseter muscle in ENoG or subjective character of EMG response analysis, and he recommended against using these tests in making therapeutic decisions in Bell's palsy.

Among methods of conservative treatment for Bell's palsy glucocorticoids remain the mainstay of treatment, whereas the efficacy of antiviral agents in monotherapy or in association with glucocorticoid is questioned (7, 8). According to the AAO-HNS guidelines (13) clinicians should recommend oral glucocorticoid no later than 72 hours after the onset of symptoms to every patient over 15 years old; additionally antiviral therapy can be recommended, but not in monotherapy. Moreover, eye protection should be implemented in every patient with impaired eye closure. The guidelines do not recommend for or against surgical treatment for Bell's palsy, though. There has been a debate for many years, if surgical treatment for Bell's palsy is relevant, and, if it is, what eligibility criteria a patient should fulfill, when surgery should be performed and which surgical approach should be chosen.

Objectives and methods

This article is a review of literature on the rationale for surgical treatment for Bell's palsy, its techniques, timing and efficacy, as well as patient's eligibility criteria for facial nerve decompression. Database PubMed was searched for the terms "surgical treatment in Bell's palsy" and "decompression in Bell's palsy" entered in conjunction between 2nd and 6th of August 2021. All studies reporting own outcomes of facial nerve decompression were included, both those comparing recovery rates in Bell's palsy between patients treated surgically and conservatively – 8 articles, and those investigating factors influencing the results of surgical treatment, i.e., patient's age, timing of decompression – 4 articles, as well as systematic reviews and meta-analyses investigating the efficacy of decompression in this entity – 2 articles. Both prospective and retrospective studies were included. Only publications in English, full texts of which were available, were included. One study was excluded, because it investigated the role of facial nerve decompression in a variety of disorders, not only in Bell's palsy. All 14 articles, which met the inclusion criteria, were analyzed by the author. Time range of publications was: 1974-2021.

Results

Relevance of surgical treatment for Bell's palsy

The relevance of surgical facial nerve decompression is supported by a supposed pathophysiological mechanism of Bell's palsy, which is strictly related to the well-known topography of the nerve, or – to be precise – to its course in a narrow canal in the temporal bone, i.e., facial canal. Facial nerve, after leaving the internal auditory canal, enters its canal in the temporal bone, where the nerve's first intratemporal portion begins – the labyrinthine segment. Fisch (14) identified this point, i.e., meatal foramen, as the site of the nerve's compression in Bell's palsy. At this point facial nerve canal is the narrowest in its entire course and measures about 0.61 mm in diameter (15). According to Fisch (14), the rationale for surgical treatment for Bell's palsy is based on the assumptions that:

1) facial nerve becomes compressed in the facial canal,
2) decompression of the compressed nerve returns the function of mimic muscles on the affected side.

The attitude towards the issue, which portion of the nerve should be decompressed, has changed over the years. At first, only a centimeter portion of facial nerve in the vicinity of the stylomastoid foramen was decompressed (16), later decompression of the entire vertical segment was performed, whereas in 70's decompression of the entire intratemporal part of the facial nerve was undertaken (17). Inflammation and oedema of the facial nerve at meatal foramen, specific for Bell's palsy according to Fisch (14), causes

the compression of the vessels that supply the nerve, which leads to ischaemia and, as a consequence, to the degeneration of nerve fibers. The concept of segmental inflammation and oedema of the facial nerve at the meatal foramen in Bell's palsy turned out to be consistent with Fisch's (14) intraoperative observations related to the morphology of the labyrinthine segment and the intraoperative EMG results while stimulating this segment in 94% of patients operated on due to Bell's palsy. A few years later Schwaber et al. (18) described the gadolinium enhancement in the labyrinthine portion of the facial nerve and in the distal segment of the internal auditory canal in MR imaging, which can also support Fisch's concept regarding proximal to the geniculate ganglion location of pathological process in Bell's palsy, not in the vicinity of the stylomastoid foramen, as was supposed earlier (16).

On the other hand, Hagino et al. (19) described swelling of the nerve in Bell's palsy in its vertical segment. Furthermore, in 2002 Adour et al. (12) strongly contradicted Fisch's concept, supporting their view with other researchers' autopsy protocols, which suggested that in Bell's palsy facial nerve is pathologically affected along its entire intratemporal course, not only segmentally. Furthermore, due to viral etiology of Bell's palsy, proposed by other researchers, in the same paper Adour et al. (12) also argued that there was no indication for surgical treatment in this entity.

Patient's eligibility criteria for surgical treatment in Bell's palsy

In some cases of Bell's palsy no clinical improvement is observed, despite administering pharmacological treatment. No wonder that for the majority of these patients persistent palsy of one half of the face remains an unacceptable prospect. Fisch's observations show that patients with paralysis, who demonstrate the degeneration of ≥95% of facial nerve fibers in ENoG within 15-21 days after the onset of symptoms, are burdened with particularly poor prognosis as to recovery. In this group the prospects of returning complete or at least satisfactory facial muscles function (HBGS I or II) are reduced to 50%. Surgical treatment undertaken in this group within 24 hours after receiving ENoG result provides no benefit (14). These observations were not confirmed by Yanagihara et al. (20), who achieved statistically significant improvement in recovery rates in patients with the above-mentioned degree of facial nerve fibers degeneration, who underwent surgery, in comparison to a non-operated group. Similarly, Inagaki et al. (21) found that facial nerve decompression was effective in patients with the degeneration of ≥95% of facial nerve fibers. These authors used transmastoid approach in contrast to Fisch (14), who operated mainly via middle cranial fossa approach. Table 1 summarizes the studies comparing surgical and non-surgical Bell's palsy groups.

Table 1. Studies comparing surgical and non-surgical groups in Bell's palsy.

Authors/ prospectivity	Approach	Facial nerve sheath incision	Timing of surgery after onset	Criteria for surgery	Form and time of follow-up after onset	Do authors recommend surgical treatment?
McNeill R, retrospective, 1974	Transmastoid	Yes	Within 14-63 days or later	– paralysis, – elevation of PST[2] for ≥3.5 mA compared to unaffected side;	Qualifying outcomes as acceptable/ unacceptable At least a year	No
Fisch U, prospective, 1981	Middle cranial fossa +/- transmastoid[1]	Yes	Within 28 days	– ENoG[3] ≥90% within 28 days after onset;	Fisch Facial Nerve Grading System[7] 1-3 years	Yes[8]
May M et al., prospective, 1985	Transmastoid	No mention	Not indicated	– eEMG[4] ≤10% of normal side, – paralysis;	HBGS[6] 6 months or longer	No
Gantz BJ et al., prospective, 1999	Middle cranial fossa +/- transmastoid[1]	No mention	Within 21 days	– ENoG[3] ≥90% within 14 days after onset, – no voluntary response in EMG[5], – complete paralysis;	HBGS[6] 7 months	Yes[9]
Yanagihara N et al., prospective, 2001	Transmastoid	Yes	Within 15-120 days	– HBGS[6] V-VI, – eEMG[4] >95% degeneration, – no facial nerve excitability with electrical stimulation of ≥10 mA;	HBGS[6] At least a year or until recovery	Yes[10]
Hato N et al., prospective/ retrospective, 2012	Transmastoid	No	Within 15-120 days	– HBGS[6] V-VI, – ENoG[3] >95%;	HBGS[6] over 12 months	Yes

Authors/ prospectivity	Approach	Facial nerve sheath incision	Timing of surgery after onset	Criteria for surgery	Form and time of follow-up after onset	Do authors recommend surgical treatment?
Li Y et al., prospective, 2016	Transmastoid	Yes	Within 60-90 days or later	– paralysis, – ENoG[3] >95% 60 days after onset, – reduced voluntary activity in EMG[5] 60 days after onset;	HBGS[6] 12 months	No
Inagaki et al., retrospective, 2021	Transmastoid	No mention	Within 18 days or later	– HBGS[6] VI, – ENoG[3] >90% at 3-21 days after onset	HBGS[6] 12 months	Yes[11]

[1] Fisch (14) and Gantz et al. (27) converted from middle cranial fossa approach to transmastoid approach in each patient operated for Bell's palsy, in whom they demonstrated via intraoperative EMG, that pathological changes took place distally to the geniculate ganglion;
[2] percutaneous stimulation threshold;
[3] electroneurography;
[4] evoked electromyography;
[5] electromyography;
[6] House-Brackmann Grading System;
[7] From: Moe KS, Li D, Linder TE et al. An Update on the Surgical Treatment of Temporal Bone Paraganglioma. Skull Base Surg 1999; 9(3):185-94. DOI:10.1055/s-2008-1058145;
[8] if ENoG 90-94% within 21 days; then surgery within 24 h after ENoG result;
[9] up to 14 days after onset;
[10] best results up to 30 days after onset;
[11] within 18 days, if ENoG ≥95%.

It seems that in every study some form of electrophysiological testing was performed prior to surgery and results served as a criterion for surgery. ENoG was the most commonly chosen form of testing; five out of eight studies used ENoG result in the range 90-95% as the eligibility criterion for surgery (14, 21, 27, 30, 33). Additionally, out of four studies, that did not have a control non-operated group (not included in Table 1), three used >90% ENoG result as an eligibility criterion for surgery (22, 23, 25). The aim of a surgery was then to prevent the progression of facial nerve fibers degeneration to the critical value of 95%. It is unclear, though, when the first ENoG testing should be performed; a few studies confirm its prognostic value in the 3.-14. day after the onset of symptoms (26). However, one has to remember that Wallerian degeneration of facial nerve fibers in Bell's palsy occurs later than in traumatic or iatrogenic nerve transection (27). Wallerian degeneration is a process that results when a nerve fiber is injured and the part of the axon distal to the injury degenerates. This process can be detected no sooner than 10-14 days after injury according to some researchers (28). Yet considering the fact that surgical treatment was proven ineffective in a few studies after confirming the degeneration of ≥95% of facial nerve fibers later than 14 days after the onset of symptoms (14) or even in patients with degeneration >90% shown in ENoG (27), the first electrophysiological test should probably not be performed later than in the 14. day of the palsy.

Techniques and efficacy of surgical treatment for Bell's palsy

The most commonly used surgical techniques are based on the assumption that pathological process in Bell's palsy takes place proximally to the geniculate ganglion. Thus, a few researchers recommended middle cranial fossa approach (14, 22, 27, 29), which provides optimal exposure of the proximal segment of the facial canal and the distal portion of the internal auditory canal. The possibility of hearing preservation in an operated patient on the affected side is an undisputed advantage of this technique. In fact, Cannon et al. (22) did not report any significant differences in hearing levels pre- and postoperatively. However, both Fisch (14) and Gantz et al. (27) reported single cases of iatrogenic hearing loss. Another aspect to be highlighted is a long list of serious potential complications, e.g., hemorrhage, infection, seizures, otorrhoea (30), and the technical difficulty of performing middle cranial fossa approach, which constitute the disadvantages of the technique. This is definitively not a standard procedure routinely performed in any ENT department. A few authors suggested good efficacy of transmastoid approach in facial nerve decompression for Bell's palsy, with its higher safety than that of middle cranial fossa approach (30, 31). Yanagihara et al. (20) and Inagaki et al. (21) achieved higher rates of recovery in patients operated via transmastoid approach in comparison with the group treated conservatively and the difference was statistically significant. Furthermore, Fisch (14) noted that during facial nerve decompression via middle cranial fossa approach EMG (with stimulus) should be performed intraoperatively in order to locate the site of pathological process. If a patient belongs to a group of 6%, in whom pathological changes in Bell's palsy take place distally to the geniculate ganglion, then surgery should be continued via transmastoid approach combined with posterior tympanotomy (14). Table 1 also summarizes the techniques chosen by researchers comparing non-operated and operated for Bell's palsy groups. In two studies middle cranial fossa alone or combined with transmastoid approach was used (14, 27) and in the remaining six – transmastoid technique alone (20, 21, 30, 32, 33, 34). The facial nerve sheath was incised in four studies (14, 20, 32, 33); in one study no sheath incision was made (30) and in the remaining three studies (21, 27, 34) it was not indicated, whether the incision was made or not. In four studies, which were missing a control non-operated Bell's palsy group, the following approaches were chosen: transmastoid

– two studies (23, 25), middle cranial fossa – one study (22), subpetrous – one study (24). The steps of subpetrous procedure were not sufficiently clarified by Bodénez et al. (24) according to the author of the present article, though. Nonetheless, the authors reported the recovery to HBGS III in all 13 patients who had undergone decompression via subpetrous approach in 12-month-long follow-up.

Every study mentioned in the paragraph above, which investigated middle cranial fossa approach, confirmed its efficacy in facial nerve decompression for Bell's palsy. Among studies from Table 1, which investigated transmastoid approach, three concluded that surgery should be recommended (20, 21, 30) and the remaining three – that it was ineffective (32, 33, 34). Kondo et al. (23) compared facial nerve decompression via transmastoid approach in Bell's palsy group with the Ramsey-Hunt syndrome group, but because in the study the control non-operated Bell's palsy group was missing, it assumed the efficacy of surgical decompression, not proved it. Berania's et al. study (25) had a similar limitation – lack of a control non-operated Bell's palsy group. Nonetheless, Kondo's et al. study (23) compared the age subgroups in patients decompressed for Bell's palsy and found that the age of ≥60 years is a negative prognosticator for facial nerve function restoration after decompression via transmastoid approach. The prognostic value of patient's age in facial nerve decompression was also emphasized by McNeill (32) years ago.

Surgical treatment for Bell's palsy – timing vs. efficacy

Apart from surgical approach, the moment of performing facial nerve decompression for Bell's palsy is also controversial. The timing of surgery in the analyzed studies with control non-operated group ranged from 14 to 120 days after the onset of symptoms (see Table 1), although not every study indicated directly the moment of the latest performed surgery. One of these studies recommended decompression within 14 days after the onset of Bell's palsy for optimal results (27); another suggested optimal outcomes within 21 days (14); Inagaki et al. (21) recommended decompression within 18 days, whereas Yanagihara et al. (20) – within 30 days. Hato et al. (30) showed that surgery even 120 days after the onset of symptoms was effective. Among the studies without a control non-operated group Cannon et al. (22) postulated that middle cranial fossa decompression of the facial nerve within 14 days provides better outcomes than surgery performed later than 14 days. Berania et al. (25) showed statistically significant improvement in facial nerve function in patients undergoing surgery within 21-89 days after the onset of symptoms. On the other hand, Li et al. (33) concluded that facial nerve decompression undertaken 2 months after the onset of symptoms offers no benefit. Deciding when to perform surgery is complex: on one hand, early decompression may stop the progression of the degeneration of nerve fibers and, thus, provide a better chance for nerve recovery; on the other hand, in some patients with initially poor prognosis, spontaneous improvement can occur and, when the decision to perform surgery is postponed, these patients avoid unnecessary surgical treatment. Some studies show that spontaneous recovery of an injured peripheral nerve occurs at a regeneration rate of 1 mm per day (1 inch per month) (35). Hence, the process of facial muscles function restoration takes months, regardless of a chosen form of treatment. This information should also influence the time of follow-up in studies exploring the efficacy of surgical decompression – in fact, the longer the follow-up, the better; it probably should not be shorter than 12 months, which was not the case in all of the studies included in this analysis.

Conclusion

There is still no consensus regarding surgical treatment for Bell's palsy. Casazza et al. (36) in meta-analysis demonstrated lower efficacy of surgery via middle cranial fossa approach performed later than on the 14. day after the onset of symptoms compared to surgical treatment via the same approach performed within 14 days after the onset of Bell's palsy. The authors also showed no benefit from surgical decompression via transmastoid approach compared to medical controls and no benefit of surgical treatment (via middle cranial fossa or transmastoid approach) compared to medical controls (36). Based on the studies included in the meta-analysis by Menchetti et al. (37), due to significant limitations of those, it is not clear whether facial nerve decompression for Bell's palsy is of benefit to a patient. Thus, no universal guidelines in this subject can be formulated for now. Interpretation of the studies' outcomes is even more challenging due to the potential of Bell's palsy to resolve spontaneously in some patients. For this reason, in Menchetti's et al. (37) meta-analysis the authors doubt whether the role of surgical treatment in this entity will be further explored. Surgical approach, which should be chosen, and the timing for facial nerve decompression remain the sources of disagreement in the field. The outcomes of different centers are not easy to compare due to their different experience, as well as different experience of individual surgeons in performing facial nerve decompression. The key questions when contemplating surgery are who and when to operate. It seems that facial nerve decompression for Bell's palsy should be considered if a patient fulfills the following criteria: the presence of paralysis in physical examination, degeneration of >90% of facial nerve fibers shown in ENoG within 14 days after the onset of symptoms and the absence of voluntary myogenic response confirmed in EMG (38). For optimal results, surgery should be performed as soon as possible after electrophysiological testing. A patient should be referred to an experienced otosurgical unit for surgical decompression, since the maximizing of chances for facial muscles function return and the avoidance of complications such as hearing loss remain of utmost importance. In author's opinion middle cranial fossa approach should be chosen, because the outcomes of studies testing this approach are most consistent. The availability of a neurosurgeon in undertaking such challenging treatment might also be of benefit. It is not clear, whether other factors, e.g., patient's age, should be taken into account when planning a surgery. In 2011 Smouha et al. (39) carried out a questionnaire among the members of American Otological Society and American Neurotology Society. To the question, if surgical treatment for Bell's palsy in a patient fulfilling clinical and electrophysiological criteria should be recommended, he received only 67% affirmative responses (39). As long as high level quality evidence lacks, clinicians' attitude towards surgical treatment for Bell's palsy will remain ambivalent.

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