Historical Review: Suspension Therapy for the Treatment of Tabes Dorsalis

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Key Words
Suspension therapy · Tabes dorsalis · Paralysis

Abstract

Background: Suspension therapy was developed by a Russian doctor, A. Motschutkovsky and at the end of the 19th century it was a popular treatment for tabes dorsalis. It was endorsed by Jean-Martin Charcot in France and Weir Mitchell in the United States; but after 10 years, it was abandoned because it proved to be useless and some patients developed paralysis. Summary: The effect of suspension upon a spinal cord affected by tabes dorsalis and a healthy spinal cord has been analyzed in the light of current knowledge. The benefits of suspension were thought to be due to an improvement in the blood supply to the spinal cord and due to the suggestibility or the placebo effect. Key Message: Analysis of the contemporary literature in the light of current research shows that suspension therapy was a powerful weapon that could cause impairment to the conductivity of the spinal cord and this has important implications for current therapy such as the use of Harrington rods.

Introduction

In the second half of the 19th century, neurology was emerging as a separate discipline throughout the world as a result of the work of outstanding clinicians like Silas Weir Mitchell (1829–1914) in the United States, John Hughlings Jackson (1835–1911) in the United Kingdom, Jean-Martin Charcot (1825–1893) in France, Moritz Heinrich Romberg (1795–1873) in Prussia and Alexey Kozhevnikov (1836–1902), in Russia [1]. The understanding of the anatomy and the pathophysiology of the central nervous system was well advanced and contemporary descriptions of individual diseases of the nervous system are recognizable today. Yet, notwithstanding the use of bromide, hyoscyamine, derivatives of ergot, quinine, mercury frictions and silver nitrates as advocated by Charcot, effective treatment for neurological conditions was virtually nonexistent prior to Paul Ehrlich’s (1854–1915) research and the subsequent development of the Salvarsan therapy for syphilis in 1910. Tabes dorsalis was the most prevalent chronic spinal condition. Therapy was limited to hot and cold baths, electrical stimulation and magnetic therapy. For a short period between 1883 and 1892, suspension therapy enjoyed widespread popularity for the treatment of tabes dorsalis. Lanska and Edmonson (1990), Goetz, Gelfland and Bonduelle (1995) and more recently Bogousslavsky (2011) and Vein (2011) have revisited the subject of suspension as a mode of treatment for tabes dorsalis, especially in the context of Jean-Martin Charcot and his work at the Salpêtrière Hospital [1–4]. They described

1 Suspension exerts traction for a short period of up to 5 min as opposed to continuous traction with weights that can be exerted for longer.
how suspension therapy was received at the time and how it was later abandoned after no improvement could be found. In their quest to understand and explain the initial enthusiasm for the procedure and its rapid demise, they attributed the short-lived success of suspension therapy to the placebo effect associated with a new treatment for an incurable disease. The authors also recognized the influence of biased reporting and misdiagnosis of a condition that presented typically fluctuating symptoms and which was poorly understood. Patients treated by suspension therapy suffered from fainting and vomiting, paralysis and even death; yet, a detailed analysis of the potentially deleterious and fatal outcome of suspension therapy is lacking. This article evaluates suspension therapy on tabetic patients and analyses the harmful impact on the spinal cord in light of current knowledge.

**History**

Suspension therapy for the treatment of tabes was not the first time that traction was exerted on the spinal column. In Europe, right from the 17th century, there was much interest in the treatment of spinal deformity [5]. Traction was first used for the treatment of scoliosis in France prior to the Revolution [6]. Antonius Nuck (1650–1692) used suspension equipment called a torque, and Johann Georg Heine (1770–1838) and Francois Guillaume Levacher de la Feutrie (1732–1816) attempted treatment upon the spine by means of mechanical beds. Charles Gabriel Pravaz (1791–1853) designed the ‘balancière orthopédique,’ which allowed patients to adjust the traction themselves by means of weights [7]. Forceful traction of the spine by means of extension beds was introduced in France by Charles-Auguste Maisonneuve (1779–1851) in the 1820s. He attempted to regulate the traction exerted by measuring the forces generated and recording them on a dial but the dangers were recognized and highlighted by M. La Chaise who observed that paralysis could occur as a result of traction. The practice was banned by the French Académie Royale de Médecine and in 1837, Maisonneuve fled the country for Moldavia [6]. Outside of France, the dangers of traction upon the spine were not widely recognized.

In the 19th century, L.A. Sayre (1820–1900) from the United States designed an apparatus to suspend patients for the application of plaster jackets for the treatment of scoliosis [8]. Osip Osipovich Motschutkovsky (1845–1903), a Russian doctor from Odessa, used Sayre’s method of treatment on a patient suffering from scoliosis (fig. 1) and noticed that the pain and the motor difficulties caused by locomotor ataxia nearly disappeared. It was not the plaster that relieved the pain but the extension of the spinal column prior to the application of Sayre’s plaster jacket. Motschutkovsky observed that suspended patients showed an increase in the length of their spine by 2.5–5 cm [9]. This observation prompted him to investigate if suspension could have a beneficial impact on diseases of the spinal cord. He adapted Sayre’s apparatus for the suspension of tabetic patients and, in 1883, he published his results on 12 cases of tabes dorsalis. He described how suspension therapy could allay pain and improve the mobility of tabetic patients and attributed this
to the elongation of the nerves and the blood vessels of the spinal cord [9].

Fulgence Raymond (1844–1910), Charcot’s former intern, had travelled to Odessa in 1883 and brought back an article unknown in France, which had been published in a Russian journal Charcot called ‘Vracha’ (Vratsch, The Physician). It was later translated into English by De Watteville in Brain in 1889 [9]. In 1888, inspired by Motschutkovsky’s findings, Charcot tasked his chef de clinique, Gilles de la Tourette, with carrying out therapeutic experiments on ataxic patients. He dedicated his 15 January 1889 lesson to the treatment of locomotor ataxia using the ‘suspension technique of Dr. Motschutkovsky of Odessa’ [10]. He reported on 18 cases, treated over three months. In 14 cases, there was clear improvement but four other cases were lost to follow up. In 1890, Charcot publicly endorsed the practice with the publication of a report that claimed an improvement in three quarters of cases (fig. 2 and 3). Because of his dominant role as the founder of neurology, Charcot’s endorsement greatly contributed to

Fig. 2. Suspension therapy carried out by Charcot at the Salpêtrière Hospital, 1889. Reproduced by kind permission of The Wellcome Library, London.

Fig. 3. Suspension therapy carried out by Charcot at the Salpêtrière Hospital, 1889 (in profile). Nouvelle Iconographie de La Salpêtrière 1889; 2:85–91. (Dr. O. Walusinski private library. Reproduced with permission.)
the dissemination of suspension therapy. ‘The great name of Charcot was such as to attract universal attention’ [11]. The popularity of the technique increased further when Weir Mitchell in the United States started using it and for a period of nearly 10 years, suspension therapy for tabes dorsalis was widely used in France, Germany, Russia, Britain and the United States.

In 1890, Gilles de la Tourette described treating 500 patients, with very marked improvement in 22%, incomplete improvement in 30–35% and no improvement in 35–40% [12]. He added, ‘Suspension must be tolerated. Based on our already long practice with this technique, lipothymia and syncope are the main, if not the only obstacles to this tolerance’. He also warned that:

‘The very enthusiasm the method generated turned out to be most damaging to it. Soon there was not one hydrotherapy center in France, not even one gym where this method was not applied. Most often it was left to the bath attendants, who knew nothing about medicine. Because the method has been incorrectly used for all ataxics, resulting in serious accidents and even sudden deaths, it has been thrown into disrepute.

In 1889, doctors started to contest the concept of the elongation of the spinal cord by this technique, claiming that changes were insignificant [13]. In 1894, Gilles de la Tourette carried out research on a cadaver, showing that:

‘This manipulation has a real action on the spinal cord and the bilateral radicular segments, but it is evidently minimal, even more so when the suspension is carried out on a living patient. (...) However, we have observed, along with others, that the forced flexion of the spinal column produced true elongation of the spinal cord and its roots, measurable with a tape measure in centimetres.

In 1897, Gilles de la Tourette used a table of his own invention associating elongation and forced lumbar flexion and reported an elongation of 1cm, mainly in the lumbar region (fig. 4) [14].

Despite the initial enthusiasm, a combination of disappointing outcomes, a lack of scientific evidence and a painful and risky procedure led to the practice being discredited although Dana continued to advocate the procedure into the 1920s as did Oppenheim for less advanced cases [1, 15].

**Method**

Motschutkovsky suspended the patient from his head through a head piece running under the chin and around the occiput at the back of the head and also from his shoulders. He used two leather straps looped under the armpits and attached to either side of a central metal crossbar firmly fixed to the ceiling through a pulley system used to lift the patient from the ground. The patient’s weight exerted vertical traction upon the spinal column (see fig. 1). Motschutkovsky recommended that the procedure be done only by a qualified practitioner. He suggested raising the patient slowly, without jerks, and suspending them initially for only one or two minutes, every second or third day and for no more than 10 minutes at a time, with an average of 4 minutes per suspension [9]. Some patients endured up to 97 suspensions. Motschutkovsky experimented with duration and frequency of suspension and observed changes in the patient’s pulse, blood pressure, breathing pattern, motor power, sensitivity, reflexes and pain levels. His method was further modified by Charcot and Weir Mitchell.

Charcot also used a variant of Sayre’s apparatus (see fig. 1, 2) but he guarded against using the Sayre’s tripod format to prevent the patients from using the frame to steady themselves, which could be dangerous. He stressed the importance of adapting the length of the straps to each patient to ensure that they were not entirely suspended by the head piece. When suspended, the patients were made to raise their arms away from their body every 15–20 seconds to transfer more weight on the headpiece and increase the

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2 Coincidentally, there are references to a bacteriologist from Odessa named Motchukoffsky who carried out the first experiments on fever therapy for mental disease but it is difficult to determine if this is the same man. (Ref Julius Wagner Jauregg, p 155.)
traction upon the spinal column. Depending on the weight of the patient, Charcot suggested a gradual increase from half a minute to a maximum of 4 minutes per suspension, with an average of 3 minutes. He suspended each patient once a day, on alternate days and on average 27 times [10]. After treatment, the patient was supported and freed from the apparatus and allowed to rest in an armchair. Charcot stressed that effective treatment should be free of pain and fatigue and accompanied only by limited discomfort.

Weir Mitchell adapted Motschutkovsky’s apparatus by suspending patients from the elbows as well as the chin and the head for 10–20 minutes and up to a maximum of 84 suspensions and an average of 44 suspensions. He reported on the treatment of 22 tabetic patients and like Motschutkovsky, he recorded physiological changes before, during and after suspension including pulse, breathing patterns, reflexes, sensibility, motor power, bowel, bladder and sexual function, pain levels and elongation of the spinal column [12].

In 1889, Russell and Taylor reported their own results from the National Hospital for the Paralytic and the Epileptic (thereon referred to as Queen Square) on a series of 45 patients of whom 32 were tabetic. They used Motschutkovsky’s apparatus and treatment was applied on alternate days and for a maximum of 4 minutes although in 8 of the patients, suspension therapy was administered every day for a maximum of 3 minutes [11].

Russell and Taylor also made a comprehensive review of the literature on suspension therapy. They analyzed the results of 22 practitioners who used variants of Charcot and Motschutkovsky’s protocols but on a smaller number of patients [11].

**Results (see table 1)**

Motschutkovsky studied a total of 16 cases of tabes dorsalis and reported an improvement in 14 of these (87.5%). The two patients who derived no benefit were in the early, ‘neuralgic’ stage of the disease leading Motschutkovsky to conclude that recent cases of tabes did not seem to benefit to the same extent as those of long standing [9]. Tellingly, he reported that he did not conduct a second course of suspension in any of his tabetic patients and unfortunately, the one who improved the most committed suicide [9].

The improvements were mostly subjective. One of the patients showed an improvement in the knee jerk reflex, an objective clinical sign, but this is described as ‘a violent jerk after 5 or 6 taps’ so hardly spontaneous (Russell and Taylor thought it ‘highly suspicious’) [11]. Another patient developed loss of movement in the legs and retention of urine but his lightning pains decreased.

Charcot treated 18 tabetic patients and claimed an improvement in 14/18 (77.7%) of his cases. He carried out 400 suspensions although four patients, who lived too far away, were suspended only a few times. Of the remaining 14, all improved, especially 8 of them and 3 of those were presented at one of Charcot’s notorious theatrical demonstrations at the Salpêtrière Hospital on the 15th January 1888 (fig. 5). Improvement was recorded in walking, standing, balance, bladder function, lightning pains, sexual function and numbness in the feet. Charcot observed a positive correlation between improvement and duration of treatment. None of the patients showed any improvement in the objective signs: knee jerk reflex and pupilary reaction. One patient with variable symptoms had a transient deterioration characterized by lightening pain and paralysis of the left upper eyelid but this was followed by an improvement. Charcot deemed the treatment to be harmless [10]!

Weir Mitchell reported an improvement in 14/22 patients (63.6%), no change in 5/22 (22.7%) and a worsening in 3/22 patients (13.6%). In two cases, he observed that the pain became worse but he reported no dramatic complications. He concluded that suspension was no better or worse than prolonged rest and massage and he suggested testing a combination of the three [16].

In their own study at Queen Square, Russell and Taylor reported that 6/32 cases of tabes dorsalis improved after

<table>
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<tr>
<th>Patient series</th>
<th>Total number of tabetic patients</th>
<th>Number of improved patients</th>
<th>Number of patients showing no change</th>
<th>Invalid results/lack of follow up</th>
<th>Number of patients with complications</th>
</tr>
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<tr>
<td>Motschutkovsky</td>
<td>16</td>
<td>14</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Charcot</td>
<td>18</td>
<td>14</td>
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<td>4</td>
<td>1</td>
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<tr>
<td>Weir Mitchell</td>
<td>22</td>
<td>14</td>
<td>5</td>
<td>3</td>
<td>3</td>
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<tr>
<td>Russell and Taylor</td>
<td>32</td>
<td>6</td>
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Many experienced faintness, vomiting, nausea, dimness of vision, head, back, neck and jaw ache and pyrexia. While most studies relied on a single set of results, Taylor and Russell followed up their cases and showed that the positive impact was at its greatest immediately after treatment but that subsequently, deterioration set in. They analyzed the causes of the improvements and described how patients were anxious to improve for their own benefit and to please the doctors. These are thoroughly modern comments. They reported no serious accidents. Three cases worsened after treatment showing increased back pain and deterioration in walking. One patient developed lumbar pain and erysipelas of the face. Russell and Taylor reported that in none of the cases was pain a severe symptom before treatment [11].

In their literature review, Russell and Taylor recorded a cumulative improvement rate of 67% or 171/255. The symptoms of tabes dorsalis were variable and after a transient improvement, patients would revert to their original state although most reported improvements in the level of pain. Some claimed to do away with their morphine medication but for most, the pain relief was transient and incomplete [11].

Overall, there were six fatal cases as a result of suspension therapy. Two patients died by strangulation from slipping of the chin strap, two others died when they suspended themselves against the doctor’s orders, a patient died after being suspended two to three times for 15 minutes and finally they reported the death of an American doctor who attempted to suspend himself.

**Discussion**

Suspension was an unpleasant, painful and unproven form of treatment with serious complications. It was popular and still in use in the early part of the 20th century. It was used almost exclusively for the treatment of tabes dorsalis, an incurable disease with a poor prognosis. Patients deteriorated steadily and lost the ability to walk due to ataxia but they retained insight and were aware of their steady loss of function.

French physicians were interested in pathology and diagnosis but not concerned with therapeutics. I timidly asked the professor after his lesson: ‘What about the treatment sir?’ Well! ... Yes, of course! Whatever you want ... exactly what you want! I wrote rapidly at random, a short prescription and, showing to him: ‘Is it like that?’ He did not even give a glance, and said to me, looking tired, irritated: ‘Naturally, of course! ... It does not matter [17]!’

Patients abandoned by orthodox practitioners sought help elsewhere. Practitioners (qualified or not) with powerful personalities, such as Anton Mesmer (1734–1815) or James Graham (1749–1795), preyed upon the gullible with incurable diseases. Stretching of the nerves (mechanically or surgically) had been fashionable as a treatment for tabes dorsalis but in the latter part of the 19th century, it was recognized as dangerous and fell into disuse [18]. Suspension, like Mesmer’s baguette or Graham’s celestial bed was dramatic, theatrical and impressed patients and doctors alike. Despite reports of complications such as paralysis and death, there was not a single spa or treatment center that didn’t have suspension equipment waiting to be used. In addition, many talented literary personalities suffered from syphilis of the nervous sys-

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**Fig. 5.** Lithography from the journal ‘l’Illustration’ on March 23, 1889; 47: 232. ‘New treatment for ataxia by suspension therapy at the Salpêtrière Hospital’. (Dr. O. Walusinski private library. Reproduced with permission.)
tem. In France, Guy de Maupassant (1850–1893), suffering from General Paralysis of the Insane (GPI) and Alphonse Daudet (1841–1897), suffering from tabes dorsalis wrote about their respective illnesses. Daudet actually received suspension therapy. Kipling also wrote about tabes dorsalis, bringing these diseases of the nervous system further into the public domain [19–21].

Tabes dorsalis was a common neurological condition and although doctors suspected that it was related to syphilis, this was not firmly established until the Wassermann Reaction (WR) was developed in 1906. This disease became rare in Europe although one of the authors saw a few burnt out cases when he was a medical student and first qualified 60 years ago. At the turn of the century, diagnosis was based on clinical manifestations as described by Oppenheim, the leading neurologist in Germany (see table 2). The debilitating shooting pains, which could appear and disappear at random, were recognized by Oppenheim as dealing with two unknown parameters so it was difficult to relate the treatment to any change in the condition [15].

Doctors did not follow the protocol set out by Charcot, which makes it impossible to assess treatment and draw scientific conclusions. There were variations in the frequency of suspension (up to 97 suspensions daily or every other day), the duration of each session (from a few seconds to 20 minutes), the means of lifting the patient (under the chin and the armpits, under the arms, under the elbows) the position of the patient (upright, supine, sitting, with their arms raised etc.) and finally the traction exerted on the spinal column (through body weight and sometimes by means of extra weights). Russell and Taylor attempted to analyze the results but the cases were too heterogeneous and the findings too anecdotal to form an opinion. They described one practitioner who suggested suspending the patients by their feet! In their witty and incisive conclusion, they questioned the advisability of restoring the sexual appetite or function in tabetic patients [11]!

Suspension therapy was a dramatic form of treatment; it impressed patients and doctors alike and from the outset, practitioners were endeavoring to find a rationale for its use, how it affected the spinal column, the spinal cord and the nerves and how these changes could bring about a cure and alleviate the symptoms.

Motschutkovsky thought that stretching of the blood vessels improved the blood supply to the spinal cord; hence, he measured the blood pressure during the treatment. Charcot advanced no view on the subject. Russell and Taylor believed that the improvements were purely subjective and the patients were anxious to improve to encourage their treating doctor. Subsequent doctors have ascribed the improvements to the placebo effect, a view advanced by Vein [1]. Suspension is a powerful procedure that can have a profound effect on the spinal cord; yet the development of paralysis following suspension therapy has been ignored or dismissed as an aberration. There has been no analysis of the significance of this phenomena or how the paralysis could be related to damage to the spinal cord as a result of suspension.

When Motschutkovsky observed a lengthening of the spine in suspended patients, he carried out further experiments. He removed the spinal processes from corpses and observed a stretching of the nerves. He believed that the improvement in the patient’s condition was not just due to the stretching of the nerves but also due to the re-

<table>
<thead>
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<th>Table 2. Tabes dorsalis clinical manifestations [15]</th>
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<tr>
<td>Lightning pains, Westphal’s sign, reflex immobility of pupils.</td>
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<tr>
<td>Weakness of bladder, Westphal’s sign, girdle sensation.</td>
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<tr>
<td>Immobility of pupils and anesthesia of the trunk.</td>
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<tr>
<td>Immobility of pupils and absence of Achilles reflex.</td>
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<tr>
<td>Atrophy of optic nerve, Westphal’s sign or girdle sensation with corresponding hypesthesia, analgesia.</td>
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<tr>
<td>Atrophy of optic nerve, lightning pains, impotence.</td>
</tr>
<tr>
<td>Attacks of vomiting, Westphal’s sign or absence of Achilles jerk or pupil immobility.</td>
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<tr>
<td>Gastric crises and anesthesia of trunk, etc.</td>
</tr>
<tr>
<td>Joint affections, analgesia, Westphal’s sign, or immobility of pupil.</td>
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<tr>
<td>Paralysis of the vocal cords (with or without fits of coughing), Westphal’s sign, immobility of pupil.</td>
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<tr>
<td>Spontaneous falling out of the teeth with sensory disturbances in the area of the trigeminus, Westphal’s sign, bladder disturbances, etc.</td>
</tr>
<tr>
<td>Oculo-motor paralysis, girdle sensation, analgesia, etc.</td>
</tr>
<tr>
<td>Atrophy of optic nerve and anesthesia of the trunk, etc.</td>
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Westphal’s sign is the absence of a knee jerk reflex particularly in tabes dorsalis.
sult of the stretching of the blood vessels, which improved the blood supply to the spinal cord (hence his observations upon the blood pressure during treatment).

Chipault and Gilles de la Tourette also carried out studies on the effect of suspension through dissection and examination of the spinal cord. In contrast to Motschutkovsky, they found that it was flexion of the spine and not vertical traction that resulted in an increase in the length of the spinal cord [22].

In 1890, in Britain, James Cagney attempted to delineate the impact of suspension upon the spinal cord by carrying out a dissection of the spinal column and the membranes of the spinal cord. He suggested that ‘an elongation of the surface of the cervical region led to a shortening of distance between the first dorsal and the last lumbar spines’. Without actually measuring the effect of traction upon the spinal cord, he argued that suspension caused a relaxation and not a stretching of the spinal cord [23]. This was disputed by Roughton, who opposed the therapy and considered it preferable for patients to remain ataxic than to submit to the pain of suspension [24].

Oppenheim did not believe in the benefit of suspension in advanced cases as it could cause softening of the cervical cord although he gave no evidence for this. He recommended using Sprimon’s apparatus, which he considered safer because in this method, the patient is suspended only from a sitting position. He claimed this could lead to alleviation in the pains, the ataxia, the impotence and even the optic disturbances [15].

The early work of the doctors of the French Academy of Medicine highlighting the dangers of forceful traction upon the spinal column was largely forgotten. It was not until the 1960s, when powerful distracting devices were introduced in the form of Harrington rods (internal) and halo-femoral and halo-pelvic traction (external) for the treatment of scoliosis that cases of paralysis were reported and doctors had to direct their attention anew to the dangers of forceful correction of the deformity of the spine.

Ransford and Manning described 118 patients placed in the halo-pelvic device. They reported 27 cases of complication including 6 abducens palsies, 5 hypoglossal palsies, 2 glossopharyngeal palsies, 6 brachial plexus palsies, 4 sciatic palsies, 2 paraplegias, 1 permanent and one recovering [25]. In their study, Wilkins and MacEwen described how patients subjected to halo-femoral traction experienced difficulty in swallowing, speech and breathing but showed an immediate relief of the symptoms when the traction was released [7].

Despite these complications, traction upon the spinal column was still being used as a form of therapy in the second half of the 20th century but there was no consensus among the professionals. Cyriax (1965), a charismatic physical medicine consultant, described using traction of 200 lbs/around 94 kg (as tested against a spring balance) with two people pulling on the patients’ legs; Yates, Goodman and Wilson described using 30–60 lbs around 14–28 kg to separate the vertebrae depending on the patient’s build [26, 27]. Their methods were empirical and they did not advance any scientific evidence to support their treatment. Other physicians recognized and reported the adverse effects of traction upon the spinal cord. Symonds showed the result of forceful manipulation, often on older people with cervical spondylosis where a degenerate disc combined with a narrowing of the spinal cord could produce infarction of the spinal cord with paralysis [28]. Wilkinson studied how turning the patients’ head or forcible extension could be sufficient to cause interruption of the blood flow to the posterior part of the brain by compressing the vertebral artery. She believed that traction was unlikely to be of much benefit and might even cause great harm [29]. Keane was concerned with the variable forces exerted on the spinal column through cervical traction. He instigated a series of experiments on a life-size dummy on which he separated the head from the trunk. He showed that the forces generated could vary fourfold with sharp rises and falls in the traction exerted (up to 20 lbs around 9.5 kg variation). He concluded that it was impossible to maintain constant cervical traction [30].

Brieg, a general surgeon, devoted his retirement to the study of spinal traction and described the ill effects of traction on the spinal cord. He carried out traction on four cadavers to calculate the degree of stretching of the spinal cord. He exposed the deep neck structures by neurosurgical technique and exerted traction by pulling on the skull. He showed that this caused elastic stretching of the medullary tissue along the entire length of the cervical cord, thereby providing scientific evidence on the impact of traction on the spinal cord. Overstretching of the medullary nerve tissue causes changes in the structure of the spinal cord and its conductivity thus demonstrating the dangers of manipulation and traction of the spinal cord [31]. Extreme traction and extraneous forces can have a deleterious effect upon a healthy spinal cord. Valentine Logue, professor of neurosurgery at Queen Square, the National Hospital for Neurology and Neurosurgery (personal communication), observed that particular care must be taken when manipulating the already damaged or diseased spinal cord since it does not respond to manipulation as a healthy cord would do. During spinal surgery to correct scoliosis, the risk of causing paralysis
through excessive traction has been monitored by using the ‘wake up’ test, whereby the patient is woken up at regular intervals during the procedure to check that they can still move their legs. This has been superseded by the use of continuous somatic sensory spinal-evoked potentials and latterly by motor-evoked potentials. Through graduated measurements during spinal surgery, doctors have demonstrated the effect of traction upon the spinal cord and how this impairs the function of the cord and can lead to paralysis. This can be relieved when the traction is released. There is a firm pathological explanation as a result of suspension therapy and based on Brieg’s findings as to the changes in function of the spinal cord and far from dismissing the changes resulting from skull traction and apportioning them to a placebo effect, the cord itself could have had its function modified and been damaged. In addition to the changes observed during spinal surgery to correct scoliosis, overstretching of the spinal cord leading to paraplegia has been observed in a prisoner held with his neck flexed by terrorists and during flexion of the neck during tracheal surgery [25]. Syphilis with its secondary, tertiary and quaternary manifestations is rarely seen in Europe today although there are cases of general paralysis of the insane. It would be unethical, to carry out clinical observations of the effect of traction upon these patients and these conclusions are only speculative as to the effect of traction upon tabetic patients.

In conclusion, the effect of traction upon the healthy and diseased spinal cord such as those affected by syphilis in the form of tabes dorsalis has been analyzed and the potential dangers of forceful traction or suspension have been discussed. Tabes dorsalis was the commonest spinal condition in the 19th century. Doctors abandoned manual stretching of the nerves to relieve this painful condition. Suspension was a continuation of their reasoning. Just as Motschutkovsky reasoned that traction upon the nerves could benefit the patients through an increase in the blood supply to the spinal cord, so also other doctors gave their own justification with little scientific evidence. Practitioners believed that it alleviated symptoms in tabes dorsalis but they did not understand its mode of action upon the spinal column and the spinal cord. Charcot refused to be drawn on the possibilities. Despite fatalities, the therapy continued to be used for a period of over 10 years and beyond. It was only with the development of the Wassermann Reaction (WR) test in 1905 and when the relationship of tabes dorsalis to an infectious disease became recognized, that the futility of mechanical treatment became apparent. The experimental work carried out by Brieg further exposed the dangers of forceful traction. He advanced scientific evidence on the dangers of stretching the spinal cord showing how it could cause irreversible changes but it was through the use of Harrington rods and halo-femoral and halo-pelvic traction to correct scoliosis in the 1960s that the true dangers of such procedures were exposed. This issue is still at the forefront of research and in a recent volume of Spinal Cord, Takahashi commented:

... biomechanical influence on the neural tissue damage remains inadequately understood [32].

Acknowledgments

We are grateful to Dr. Eric Nieman for his constructive advice and also to the Wellcome Library for permission to reproduce the illustrations.

Disclosure Statement

None declared.
23 Reports on Society Royal Medical and Chirurgical Society: British Medical Journal 1890, p 131.
24 Reports on Society Royal Medical and Chirurgical Society: British Medical Journal 1890, p 238.