George Riddoch (1888–1947): the driving force behind the treatment of spinal injuries in the UK during the Second World War

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Abstract The development of the successful treatment of spinal injuries has been inextricably linked to Sir Ludwig Guttmann and Stoke Mandeville Hospital. The role of George Riddoch has largely been ignored or mentioned merely in relation to Ludwig Guttmann and his appointment as the first Resident Medical Officer at Stoke Mandeville Hospital. Riddoch's contribution was far more significant. New material, comprising Riddoch's letters and memoranda written between 1939 and 1944, reveals his paramount involvement in the setting up of spinal injury units across the UK between 1941 and 1944, and his skill as an administrator and a clinician. Riddoch must be given credit for finding and appointing Ludwig Guttmann.

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Introduction

The development of the successful treatment of spinal injuries has been inextricably linked to Sir Ludwig Guttmann (1899–1980) and Stoke Mandeville Hospital. The role of George Riddoch has largely been ignored or mentioned merely in relation to Ludwig Guttmann and his appointment as the first Resident Medical Officer at Stoke Mandeville Hospital. Riddoch's contribution was far more significant. He was responsible for the establishment of acute and chronic spinal injury units during the Second World War across the UK; he set out directives on the transportation and the treatment of those patients, and monitored their progress and their rehabilitation. This paper aims to redress the balance and acknowledge our debt to Riddoch for the development of spinal injury services during wartime in the UK.

Riddoch's involvement in the treatment of spinal injuries during the First World War is well documented.[1] His influence in the establishment of the spinal unit at Stoke Mandeville Hospital with the appointment of Ludwig Guttmann has also been recently described.[2] Both accounts draw on Public Record Office documentation, the Official History of the Emergency Medical Services (EMS) and a contemporaneous MD thesis.[3,4] This paper is based on new material donated by Jill Blau, widow of the neurologist Nat Blau. This archive, comprising Riddoch's letters and memoranda written between 1939 and 1944, reveals his paramount involvement in the setting up of spinal injury units across the UK between 1941 and 1944, and his skill as an administrator and a clinician. It highlights the difficulties he faced with regard to first aid, transportation, staffing and the implementation of treatment directives.

Historical background

When Britain declared war on Germany following the invasion of Belgium in 1914, the British Government was unprepared for warfare and its consequences. Medical provision relied on voluntary hospitals run on a charitable basis all over the UK and local authority institutions. Such was the shortage of beds that asylums (mental institutions), workhouses and private country houses were requisitioned and adapted to receive casualties. Prior to an offensive in France, the Government would issue an order to London hospitals to free beds in preparation for anticipated casualties. There was no organised transport of casualties and the injured were left to linger on stretchers by the roadside and in railway stations. Soldiers who sustained a spinal injury rarely survived the battlefield, and the high death rate from such a catastrophic injury made it impossible for the medical profession to learn from experience how a patient with a spinal injury should be treated. The few survivors were initially treated at Base Hospitals 13 and 16 in Boulogne, under the care of Gordon Holmes (1876–1965), from where officers were transferred to the Empire Hospital in London under the care of Henry

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Head (1861–1940) and George Riddoch, whilst other survivors were cared for on a custodial basis in hospitals scattered across the UK. The only facility dedicated to the long-term care of patients with spinal injuries was the Star and Garter Home in Richmond, where treatment was desultory as little was understood about the management of this condition.

In contrast, when another war in Europe became inevitable because of the rise of the Nazi party in Germany, the Government took steps to prepare the country both militarily and medically through rearmament and by making provisions for facilities for the treatment of casualties. In 1926, the Royal Air Force had estimated that for each ton of bombs dropped, there would be about 17 killed and 33 wounded, and 1,000 tons of bombs would be dropped in the first day of the outbreak of war. This provided a figure of 33,000 wounded, which was expected to decline to about half that number by day three and remain at that level for the following month and then continue to fall.[3] It was estimated that a million beds would be required by the outbreak of war. Existing hospitals were inadequate, and to meet this need hutted hospitals were built throughout the UK to form the EMS for the treatment of civilian and military casualties, primarily from air raids (Figure 1). When war broke out the expected air raids did not at first materialise (the 'Phoney War') and the empty beds were used for the routine treatment of the population.

The newly formed EMS gave central Government a right of direction over both Voluntary and Local Authority Hospitals, which it had never before possessed, and also control of the newly erected temporary facilities in the form of hutted hospitals, which remained in use for many years after the war. The Medical Superintendent remained in administrative charge of the whole hospital. This scheme provided the comprehensive structure required to enable the delivery of medical services across the country.

Doctors realised that servicemen who sustained an orthopaedic injury or an injury to the head, spine or peripheral nerves would require specialised treatment in designated units.[5] However, because so few patients survived a spinal injury in the First World War, few doctors had gained the necessary experience in treating such injuries. Only three doctors had the knowledge required: Henry Head (deceased in 1940), Gordon Holmes (too old to take on such a challenging role) and George Riddoch, who by then was acknowledged as an expert in the field. Having established an outstanding reputation as a neurologist during the First World War, Riddoch was the perfect candidate to oversee the establishment of neurological facilities for the treatment of peripheral nerve and spinal injuries during the Second World War.

George Riddoch (1888–1947)

Riddoch accomplished much in his short life. Born and educated in Scotland, he qualified in medicine with a first class honours degree from Aberdeen University in 1913 (Figure 2). There he worked as a demonstrator in the Anatomy Department, thereby gaining a thorough knowledge of anatomy that held him in good stead for his future career as a neurologist. He came to London and worked as a Resident at the West End Hospital for Nervous Diseases where he gained invaluable experience. A doctor with neurological training was rare in those days (Gordon Holmes was the only neurologist in the British Army), so in 1914 Riddoch was appointed as a Captain in the Army, and officer in charge of casualties at the Empire Hospital for injuries of the nervous system. He gained considerable experience in treating spinal injuries by virtue of being solely responsible for every aspect of patient care. Riddoch worked with Head, the outstanding neurologist and neurophysiologist in the UK who recognised Riddoch's ability, and they carried out seminal research on the neurophysiology of the bladder resulting in a collaborative paper on the autonomic bladder.[6] When the war ended, Riddoch was appointed neurologist to the Maida Vale Hospital and to the staff of the medical unit at the London Hospital. Riddoch maintained his interest in spinal injuries between the wars and chaired meetings on this subject at the Royal Society of Medicine.

Figure 1 Picture of hutted wards at Stoke Mandeville Hospital (personal photograph)

When the Second World War broke out, the neurological unit of the London Hospital was evacuated to the Chase Farm Hospital in Enfield where Riddoch was appointed as head of the EMS neurological unit. In 1941, he accepted a commission as a Brigadier and with Hugh Cairns (1896–1952) they devoted themselves to the organisation of the Army Neurological Services. Riddoch was also a member of the War Office Medical Board and chaired the Nerve Injuries Committee for the Medical Research Council. In 1941, he was given the responsibility of setting up spinal and peripheral nerve injury units across the UK.

Figure 2 George Riddoch, Physician to the London Hospital, 1947. Reproduced with kind permission of the Wellcome Library, London

Riddoch's correspondence (1939–44)

During the Second World War, George Riddoch's involvement was not limited to spinal injuries as he issued a report on an enquiry to establish additional centres for the treatment of peripheral nerve injuries.[7] This paper specifically addresses the treatment of spinal injuries.

Riddoch's vision for the setting up of spinal units

Riddoch understood the need for two types of spinal injury unit: acute and chronic. A distinction was made between acute spinal trauma (where the patient was also suffering from intercurrent injuries) and long-term incurable cases. The former required resuscitation, bone and spinal cord surgery and access to pathology and radiography departments, and all the facilities of a neurosurgical and orthopaedic unit.[1] The latter required rehabilitation facilities, including physiotherapy and occupational therapy, and a long-term goal to return as many patients as possible to some form of employment.

Despite studying the Public Record Office documents and Riddoch's newly discovered correspondence, both of which make numerous references to the various hospitals where spinal injury patients were treated, it has proved difficult to identify acute and chronic units with any certainty (Box 1).

The lists of hospitals taking care of these patients were regularly amended in the face of requests by the Government for extra beds for spinal injury and head injury patients, forcing Riddoch to seek accommodation anywhere possible. Furthermore, Riddoch's remit was not limited to England but extended to Scotland and Wales.[8]

Riddoch envisaged that acute units would have a full-time resident medical officer in charge and would be staffed by a neurologist, a neurosurgeon, a genitourinary surgeon and an orthopaedic surgeon.

In 1944, faced with an increasing number of casualties with spinal injuries, the War Office issued a further memorandum to secure more beds by increasing the number of nursing staff. That summer, Riddoch visited the North of England in order to assess various hospitals as to their suitability as spinal units, discussing possible staff and their experience.[9] Further units were also considered, such as Hexham and Pinderfields.

Staffing difficulties were exacerbated by a shortage of nurses and orderlies in the face of increased demand for beds and a dearth of suitably qualified doctors, such as neurologists, neurosurgeons, orthopaedic surgeons and genitourinary surgeons, to treat such patients. These were new specialties with few appropriately qualified doctors.

When the shortage of beds for the treatment of acute cases of spinal injuries was at its greatest in 1944, Riddoch wrote to Frankau to recommend that such cases be transferred for immediate attention to neurological or neurosurgical units in preference. He lists Stoke Mandeville, St Hugh's, Winwick, Liverpool, Wharncliffe, Newcastle General or Barnsley Hall, implying that each of these hospitals could accommodate six cases each.[10] Riddoch did not just volunteer beds; he took it upon himself to speak to the individuals concerned to prepare them for this eventuality. He wrote:

> Military Hospital (Head Injuries), St Hugh's Oxford has agreed to take about 20 (spinal injury) patients…Saw McKissock (neurosurgeon) last Thursday. He thinks that a paraplegic unit could be incorporated in the Head Injury Centre.[7] (Figure 3)
>
> Professor Cohen (professor of medicine at Liverpool with no experience of treating spinal injuries) has told me that if the Hospital Officer agrees he could take 12, or in fact up to 24 patients with traumatic paraplegia into beds which are reserved for the present emergency, and it is clear the [sic] his team could cope with them well.

This illustrates the desperation for additional beds and the concern that traumatic cases should be treated urgently and adequately.

Riddoch discussed individual candidates with colleagues to assess their suitability, and tried to resolve staffing

Box 1 Spinal injury centres mentioned in the correspondence

Acute units

- Winwick EMS hospitals
- Stanmore Royal National Orthopaedic Hospital (RNOH)
- Stoke Mandeville Hospital
- Park Prewett, Basingstoke
- Barnsley Hall, Birmingham
- Queen Elizabeth Hospital Birmingham
- Wharncliffe
- Royal United Bath (and at Peripheral Nerve Injury Centre at St Martins)
- Newcastle General Hospital
- EMS Fulwood Annexe, Royal Hospital Sheffield
- EMS Dryburn, near Durham
- Killearn, near Glasgow, Scotland
- Hurstwood Park Haywards Heath
- Gogaburn, near Edinburgh, Scotland
- EMS Leatherhead (blind school)
- St Hugh's Oxford

Chronic units

- Broughton House, Kersal
- Wyborne Gate, Southport
- Ellerslie House, Nottingham
- Hospital for officers, Brighton
- Erskine House, Brighton
- Gifford House, Worthing
- St David's Home, Ealing
- Sherburn Hospital, Durham
- Star and Garter, Richmond
- Dunstan Hill

issues by issuing memoranda and letters requesting that staff should be dedicated to the peripheral nerve injury and spinal injury units and not have to divide their time across other departments or outside commitments. He understood how important it was that the doctors devoted themselves exclusively to the care of the patients.

Towards the end of the war, staffing shortages were addressed by releasing the Royal Army Medical Corps nursing orderlies from the Army to employ them in spinal injury centres.[11,12]

The practical reality

Riddoch's ambition for specialist teams proved unrealistic. At Barnsley Hall he struggled to find a genitourinary surgeon and the Medical Superintendent had to divide his time between the Asylum and EMS hospital.[13] Similarly, Riddoch complained that at Winwick the orthopaedic surgeon Mr Cullen and the neurologist Dr Dixon visited outside hospitals and could not dedicate themselves exclusively to the spinal unit, which would have enabled them to treat more cases of paraplegia.[9] At Stoke Mandeville Hospital, in desperation, Riddoch even offered to carry out the neurology care himself.[2]

Treatment directives and research

Riddoch understood the importance of attention to detail in the treatment of spinal injuries, where a single mistake can have fatal consequences. He involved himself in the minutiae of care and his treatment directives in the correspondence are so detailed as to evoke the immediacy of the patient. He entered into correspondence with Fraser, Holmes and Guttmann to obtain feedback and consensus on the various treatment directives he issued. The archive contains eight memoranda issued between 20 February 1940 and July 1944. These addressed in great detail all aspects of traumatic spinal injury care from transportation to first aid, and early treatment to the management of the bladder and bowel. Acutely aware of the need to train and guide staff who often had no nursing experience of such cases, Riddoch attempted to standardise the care given to such patients by setting out in detail how they should be treated:

> The importance of ensuring adequate first-aid and early treatment for the victims of spinal injuries has led the Nerve Injuries Committee of the Medical Research Council to publish the memorandum which we reprint below for the benefit of officers in the Army.[14]

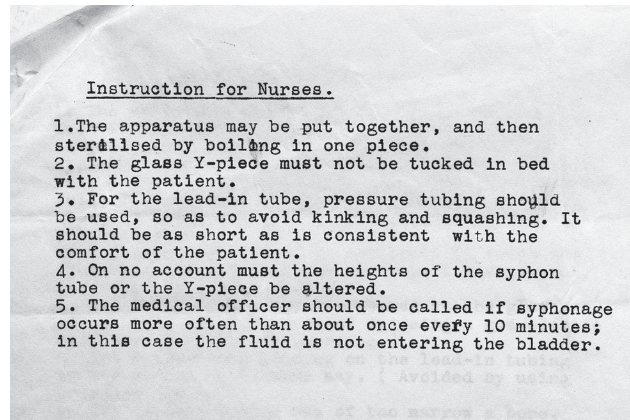
This attention to detail is well illustrated in a document reproducing part of Munro's tidal drainage apparatus with an illustration from the *Lancet*, to which Riddoch has added step-by-step instructions for nurses carrying out the procedure followed by a page addressing possible faults with the apparatus (Figure 4):

> Description: all that is needed, apart from rubber tubing is a glass Y-tube, a glass connection to go between the lead-in tube and the catheter, and a drip-bulb with open side-arm.[15]

Riddoch was familiar with the practicalities of first aid and early treatment, having experienced these himself first hand during the First World War, and he regularly monitored the impact of his directives.

Riddoch did not just issue orders, he continued to monitor the situation and if required he altered his directives as illustrated in his amendment to the Memoranda on Injuries to the spinal cord and cauda equina released in April 1944, in which he addressed transport, the use of plaster jackets and plaster beds, amid much controversy, how to avoid the stiffness of paralysed limbs and more information on the care of the bladder and bowel.[16]

Figure 3 Patients and nurses in the grounds of St Hugh's College, Oxford. Reproduced with kind permission of the Principal and Fellows of St Hugh's College, Oxford



Instruction for Nurses.

1.The apparatus may be put together, and then sterilised by boiling in one piece.
2. The glass Y-piece must not be tucked in bed with the patient.
3. For the lead-in tube, pressure tubing should be used, so as to avoid kinking and squashing. It should be as short as is consistent with the comfort of the patient.
4. On no account must the heights of the syphon tube or the Y-piece be altered.
5. The medical officer should be called if syphonage occurs more often than about once every 10 minutes; in this case the fluid is not entering the bladder.

Figure 4 Riddoch's instructions to nurses on the use of tidal drainage (Riddoch archives)

Riddoch's expertise was recognised and in March 1944, Sir Francis Fraser, from the Ministry of Health in Whitehall, asked him to comment on a document aimed at Casualty Services and for training in first aid in cases of fractures of the spine.[17] In his reply, Riddoch guards against burns from hot water bottles.[18]

Riddoch was not afraid to learn from others as far afield as India about the care of traumatic paraplegia.[19] He communicated with Colonel JA MacFarlane from the Canadian Military Headquarters to enquire how they treated the bladder in cases of paraplegia.[20,21] Riddoch's memoranda formed the basis of another directive on first aid management of fractures of the spine and neck issued by the Fracture Committee of the British Orthopaedic Association. Under the direction of Mr Watson-Jones (1902–72), they were anxious to diverge as little as possible from the official EMS and Medical Research Council Publications as drafted by Riddoch and Fraser.[16] This illustrates how influential Riddoch's committee was at the time and how far-reaching his input was (miners, St John's Ambulance, Civil Defence, Ministry of Fuel and Power).

Riddoch dedicated much time to monitoring the units through a questionnaire, asking the superintendents in charge for progress reports on each patient and mortality data. This data collection shows a desire to standardise the approach to the treatment of spinal injuries, but also a determination to learn from each unit to improve performance.

Transportation

In 1940, the Ministry of Health circulated a Memorandum on Injuries of the Spinal Cord and Cauda Equina to Group Officers and Hospital Officers.[22] This was to draw attention to the importance of transferring such patients to specialised centres, which at the time numbered only four: The Robert Jones & Agnes Hunt Orthopaedic Hospital at Oswestry, Winwick, Haywards Heath and the Royal National Orthopaedic Hospital, Stanmore.

Riddoch's notes on the document indicate that he disapproved of a number of these directives, particularly the suggestion that plaster beds could be used to immobilise the patient and for transportation:

> Experience has shown that the use of plaster beds and plaster jackets in cases of injuries of the cord and cauda equina involves a grave risk of severe bed sores, and as a rule these methods of splinting he [sic] spine should be avoided.[16]

With regard to transporting cases with spinal injuries, Riddoch had previously commented to Fraser:

> I would have thought it might have been better to describe one or two reliable methods and to discard the others.[18]

Riddoch understood the importance of early transport and admission to a specialised unit. He also detailed how patients should be moved:

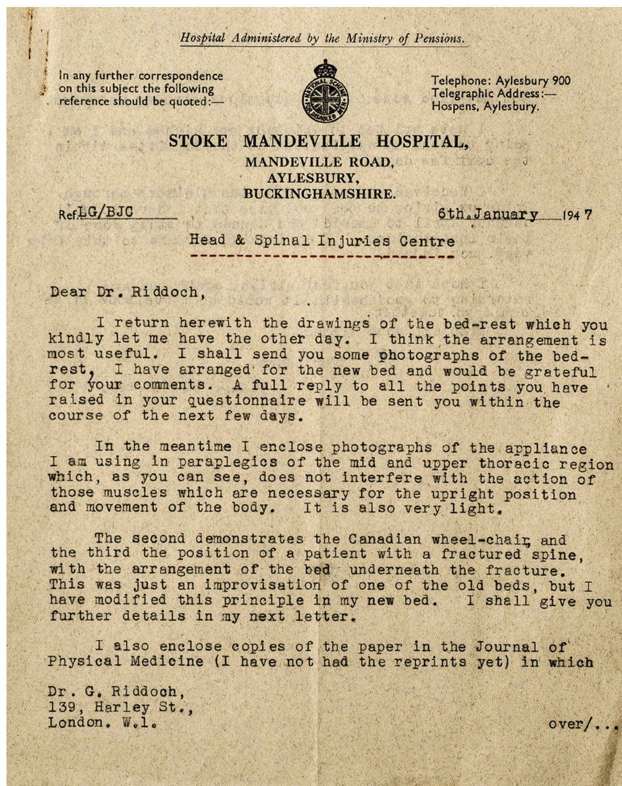
> The huge bedsores which practically all these patients get seem to arise mostly during transportation. I think there should be a rule that during transportation all paralysed patients have their position slightly altered on the stretcher every hour. They should have a prominent label attached to them instructing this and giving the reason for it.[23]

This directive was duly inserted in the Supplement No. 13 on 'First Aid and Early Treatment in Traumatic Paraplegia', adding that whenever possible the patient should lie on a soft mattress or failing this his buttocks should be supported by an air ring.[24]

Follow up and employment

The Ministry of Pensions were concerned with the rehabilitation of paraplegic patients and Riddoch was again consulted. Riddoch's opinion on the subject of rehabilitation was sought when he was invited by the Ministry of Pensions to talk with them as to the arrangements they should make for the rehabilitation of paraplegics.[25] At their instigation, he issued a questionnaire to all the spinal units asking for progress reports on the rehabilitation of the paraplegic patients in

Figure 5 Stoke Mandeville Hospital headed paper showing that it was operating as a Head and Spinal unit (Riddoch archives)



Hospital Administered by the Ministry of Pensions.

In any further correspondence on this subject the following reference should be quoted:—

Telephone: Aylesbury 900
Telegraphic Address:—
Hospens, Aylesbury.

STOKE MANDEVILLE HOSPITAL,
MANDEVILLE ROAD,
AYLESBURY,
BUCKINGHAMSHIRE.

Ref. LG/BJC

6th.January 1947

Head & Spinal Injuries Centre

Dear Dr. Riddoch,

I return herewith the drawings of the bed-rest which you kindly let me have the other day. I think the arrangement is most useful. I shall send you some photographs of the bed-rest. I have arranged for the new bed and would be grateful for your comments. A full reply to all the points you have raised in your questionnaire will be sent you within the course of the next few days.

In the meantime I enclose photographs of the appliance I am using in paraplegics of the mid and upper thoracic region which, as you can see, does not interfere with the action of those muscles which are necessary for the upright position and movement of the body. It is also very light.

The second demonstrates the Canadian wheel-chair, and the third the position of a patient with a fractured spine, with the arrangement of the bed underneath the fracture. This was just an improvisation of one of the old beds, but I have modified this principle in my new bed. I shall give you further details in my next letter.

I also enclose copies of the paper in the Journal of Physical Medicine (I have not had the reprints yet) in which

Dr. G. Riddoch,
139, Harley St.,
London. W.1.

over/...

order to assess whether they 'could be trained under suitable conditions to obtain remunerative employment.[26] At Stoke Mandeville, an agreement was entered with a local company, 'EKCO works', for patients to 'try their hand at work' for a remuneration of up to £1 a week; however, they encountered attendance issues as a result of transport difficulties.[27]

Discussion

Riddoch's competence, dedication and influence in the setting up of spinal units during the Second World War was not serendipity but the result of a thorough grounding in neurology, neurosurgery and research, reinforced by practical experience in treating paraplegics during the First World War. Riddoch's credentials and his invaluable experience in the field gave him the knowledge and the authority to implement and monitor his directives. The ability to carry out research is not an innate skill, and Riddoch's constant evaluation and search for improvement originated from the research training he acquired under Henry Head, just as Gordon Holmes had trained under Edinger, Head under Hering in Prague, and Ludwig Guttmann learned from Foerster in Germany and Medawar and Cairns in Oxford. All of them recognised the opportunity afforded by studying patients with spinal injuries, especially Foerster who regarded every patient as a unique physiological specimen to be experimented on as described by Zulch:

> Foerster never missed an opportunity during an operation on the nervous system to establish by electrical stimulation the function of the exposed parts.[28]

Figure 6 Patients eating in the middle of the ward at Stoke Mandeville Hospital. This is not a contemporaneous photograph but it reflects the conditions at the time nevertheless (personal photograph)

Above all Riddoch was a brilliant administrator, as implementing neurological services across the country in such a short period of time required skill and determination. His experience during the First World War gave him the clinical expertise to understand what was required. It was not sufficient to recognise the need for designated spinal units. There had to be the knowledge of how to treat the patients and this knowledge had to be acquired. Holmes learned in Boulogne, Head had worked at the Empire Hospital, Guttmann learned from Foerster who had extensive experience during the First World War treating these patients, operating on them and he had written extensively on the subject.

Riddoch's military training provided him with organisational skills, but without the EMS, the precursor of the future National Health Service, he would not have benefited from the hospital framework and the authority this gave him to implement this demanding task. The archives demonstrate Riddoch's open mindedness, his willingness to consult and learn from others, his excellent communication skills and his concern for the welfare of the patients. The letters also highlight his deep understanding of the treatment requirement at all levels.

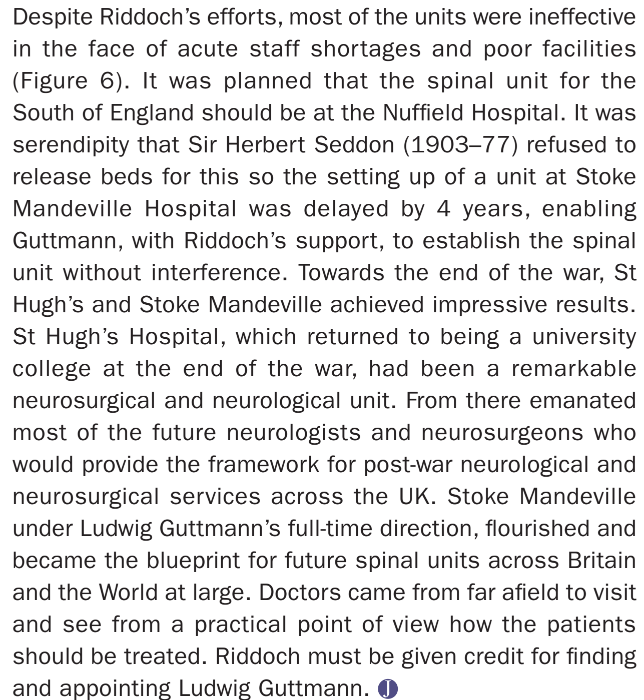
Riddoch visualised a specialised approach to the treatment of spinal injuries at a time when specialisation was resisted, and he struggled to implement his directive that one doctor should be in full charge of the spinal injury patients

and specialists should be available for the neurology, neurosurgery and genitourinary care of the patients. In the UK doctors were expected to remain generalists, and there was a concern that congregating spinal injury patients together, whilst beneficial to the patients, could lead to low staff morale and the same argument was advanced for tuberculosis or polio hospitals:

> Specialisation as a rule is advantageous to the patients, but in cases of this character doubt has been expressed whether the strain especially in the early stages, is not too great for the patients and the nurses. The heavy mortality in the early days has a depressing effect on both patients and nursing staff, but the advantages of concentration and specialisation were so great as far to outweigh the disadvantages.[29]

Initially, the units were set up as neurotrauma units caring for patients with head injuries, peripheral nerve injuries and spinal injuries, such as at Winwick, Bangour, Stoke Mandeville, Barnsley Hall and St Hugh's (Figure 5). There were two different approaches to the treatment of spinal injuries, on the one hand neurotrauma units that combined neurological, neurosurgical and spinal units, and on other hand separate spinal units. These different approaches continued after the war.

In the US under Donald Munro (1889–1973), specialised treatment of spinal injuries was very advanced and Riddoch learned from a Canadian unit that was achieving good results implementing Munro's methods, in particular tidal drainage.



Despite Riddoch's efforts, most of the units were ineffective in the face of acute staff shortages and poor facilities (Figure 6). It was planned that the spinal unit for the South of England should be at the Nuffield Hospital. It was serendipity that Sir Herbert Seddon (1903–77) refused to release beds for this so the setting up of a unit at Stoke Mandeville Hospital was delayed by 4 years, enabling Guttmann, with Riddoch's support, to establish the spinal unit without interference. Towards the end of the war, St Hugh's and Stoke Mandeville achieved impressive results. St Hugh's Hospital, which returned to being a university college at the end of the war, had been a remarkable neurosurgical and neurological unit. From there emanated most of the future neurologists and neurosurgeons who would provide the framework for post-war neurological and neurosurgical services across the UK. Stoke Mandeville under Ludwig Guttmann's full-time direction, flourished and became the blueprint for future spinal units across Britain and the World at large. Doctors came from far afield to visit and see from a practical point of view how the patients should be treated. Riddoch must be given credit for finding and appointing Ludwig Guttmann.

Acknowledgement

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