■ HISTORICAL NOTE

The Thomas splint

ITS ORIGINS AND USE IN TRAUMA

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The Thomas splint is a common piece of equipment in emergency departments and orthopaedic units in hospitals worldwide. Its basic design has changed little since its first description by Hugh Owen Thomas was published in 1875. We have reviewed the origins of the Thomas splint as a means of correction of deformities of the lower limb and its evolution through both World Wars into an essential item for the management of trauma of the lower limb.

The Thomas splint is considered to be an essential piece of equipment in emergency and orthopaedic units in hospitals worldwide. Its basic design has changed little in the 133 years since its description by Hugh Owen Thomas in his book *Diseases of the hip, knee and ankle joints with their deformities, treated by a new and efficient method*.[1] The popularity and success of the Thomas splint can be attributed to the simplicity of its design, the ease of use and its effectiveness in immobilising fractures of the lower limb, reducing the morbidity and mortality from these injuries. This article examines the origins of the Thomas splint as a means of correction of deformities of the lower limb and looks at its evolution through the World Wars in the management of trauma to the lower limb.

Hugh Owen Thomas

Hugh Owen Thomas (1834 to 1891) (Fig. 1) was from a family of Welsh bone-setters, descended from the survivor of a shipwreck off the coast of Anglesey in North Wales in 1745. The family tradition of bone-setting was passed down from father to son over three generations. His father, Evan Thomas, left Wales at the age of 19 years and settled in Liverpool where he set up a practice for the treatment of fractures and of bone and joint diseases.[2] He was not a qualified medical practitioner and his unorthodox methods of treatment, although widely successful, had many critics and opponents. He saw the advantages of formal medical education and resolved to send all five of his sons to medical school, where they all subsequently qualified.

Hugh Owen Thomas was born in Bodedern in Anglesey, where he spent much of his childhood because of ill health. At the age of 17 years he served a four-year apprenticeship with his uncle, Dr Owen Roberts of St Asaph. He studied medicine from 1855 to 1857 at the University of Edinburgh and subsequently transferred to University College, London, where he completed his studies. He qualified as a member of the Royal College of Surgeons in 1857, at the age of 23 years. He then spent a period in France where he studied in Paris.[3] After this he joined his father in his Liverpool practice for a short time before setting up as a general practitioner in the deprived areas of Victorian Liverpool. Instinctively, he specialised in the study and treatment of injuries and diseases of the locomotor system, particularly tuberculosis.[4] He had an extremely busy practice, treating among others injured dock workers and seafarers whose injuries might have been sustained weeks or months earlier while at sea. His methods were based on the family tradition of bone-setting, to which he brought his own astute observations and his knowledge of orthodox medicine and surgery. He was a strong believer in the natural ability of the body for recovery, accordingly advocating the use of rest as a means of treatment. Rest was to be "enforced that the patient's ordinary movements will not materially jar the joint, uninterrupted, even momentarily, so as not to arrest or delay the progress to cure, and prolonged to secure beyond relapse the resolution of the disease".[1] He achieved this by complete immobilisation of the diseased part in one of his many ingeniously designed splints or "machines".[1] His success meant that his practice grew rapidly and in 1866 he was forced to relocate to larger premises at 11 Nelson Street, Liverpool, which

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HUGH OWEN THOMAS,

Fig. 1

A picture of Hugh Owen Thomas from *Menders of the maimed* by Keith[3] (1919) by permission of Oxford University Press.

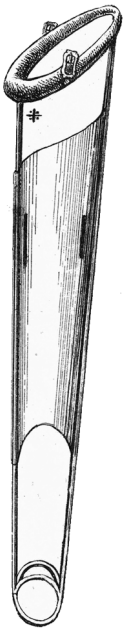

Fig. 2

Diagram of the original Thomas knee splint. *From Diseases of the hip, knee and ankle joints, with their deformities, treated by a new and efficient method* by Thomas (1876).[1]

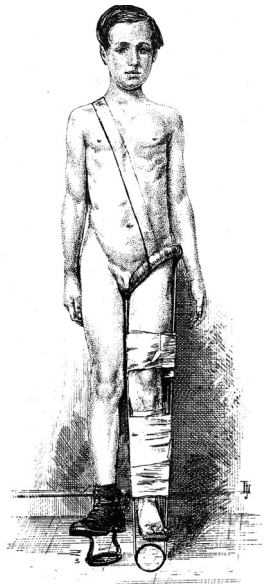

Fig. 3

Diagram illustrating how the addition of a patten beneath the shoe of the sound limb enabled the patient to mobilise in the splint. From *Disease of the hip, knee and ankle joints, with their deformities, treated by a new and efficient method* by Thomas (1876).[1]

consisted of two waiting rooms, four consulting rooms, a surgery and a workshop in which his splints and appliances were produced, individually fitted for each patient, with the aid of a blacksmith and a leather-worker.

The Thomas splint

The earliest splint was first used in 1865 for treating diseases of the knee such as tuberculosis by prolonged rest and immobilisation,[1] and only later for the management of fractures of the lower limb. It consisted of a proximal oval ring padded with boiler felt and leather, which fitted around the groin, using the ischial tuberosity as a fixed point (Fig. 2). This ring was attached by two iron rods to a smaller ring below. The inner rod was attached to the proximal ring at an angle of 45°, with padding this angle increased to 55°. An apron of leather was stretched across the two bars to support the limb. Strapping was applied to the leg and traction was gained by tying this to the cross-bar at the distal end of the splint.

The addition of a patten to the distal ring and to the shoe of the sound limb allowed the patient to walk in the splint (Fig. 3). The simplicity of the design was not accidental since Thomas recognised that his appliances should be affordable enough to allow treatment of even the poorest of patients in locations away from the wealthy charitable medical institutions found in large towns and cities at that time. He commented that his splint "will enable any surgeon to treat his cases at home, with no more mechanical assistance than can be rendered by the village blacksmith and saddler, and the poorer class of sufferers will, at a small cost, be assisted as effectually as the wealthier classes".[1]

It was in the treatment of fractures of the lower limb, particularly of the femur, that the Thomas splint became best known. Its introduction into wider practice owes much to Sir Robert Jones, the nephew of Hugh Owen Thomas, who went to live with his uncle at the age of 16 years, became his pupil and pursued a medical career. In 1888 Robert Jones was appointed surgeon to the Manchester ship canal project where he set up the first accident service

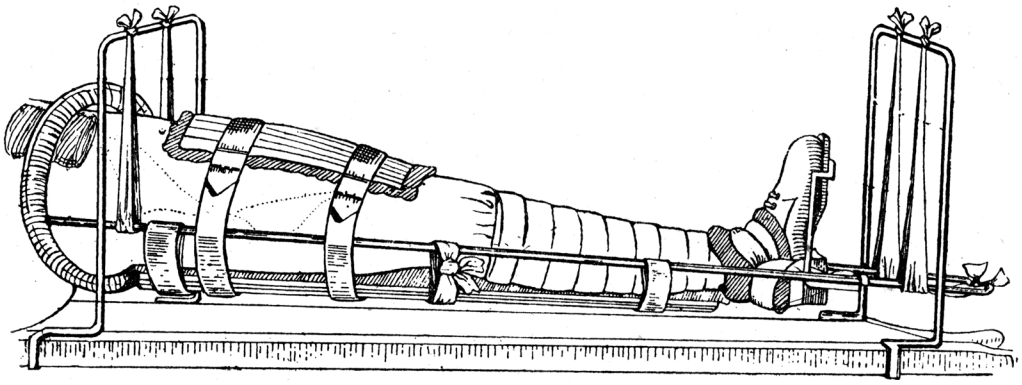

Fig. 4

Diagram showing the casualty on a stretcher with a Thomas splint applied over the boot and clothing. This demonstrates how the splint was suspended from proximal and distal bars to improve comfort (from *Early treatment of war wounds* by Gray[7] (1919) by permission of Oxford University Press).

in order to treat the numerous casualties which resulted. His ideas on the organisation of trauma care and the treatment of fractures were way ahead of their time. As a result of his success he was appointed consultant orthopaedic surgeon to the British army during the First World War. In a letter to the *British Medical Journal* published in December 1914, he advocated the use of the splint in fractures of the middle and lower thirds of the femur, knee and upper tibia.[5] He recognised its superiority in reducing and immobilising fractures, allowing easy surgical access for debridement of compound injuries and providing a simple means for transporting patients comfortably. It was his introduction of the Thomas splint to the Western front which brought recognition to the appliance, but unfortunately it was not supplied routinely to army medical teams until 1917.

At the beginning of the First World War the management of femoral fractures, which were usually compound ballistic injuries, was such that most soldiers with these injuries died. The existing methods of splintage of fractures were inadequate and the initial treatment of casualties was often greatly delayed. Many figures are quoted for the reduction in mortality from open fractures of the femur following the introduction of the Thomas splint. The sources of those figures are not always clear.[6] However, in his book, *The early treatment of war wounds*, the distinguished First World War military surgeon Sir Henry Gray stated that during one particular battle in spring 1917, when the Thomas splint was used for nearly all femoral fractures, the death rate at the casualty clearing stations was 15.6% in 1009 cases.[7] This was a notable reduction in mortality from earlier in the war, when Gray estimated that the death rate from gunshot fracture of the thigh was 80%.[7] Some military surgeons had previously suggested that more lives would be saved if amputation was carried out in all cases of femoral fracture. However, only 17.2% of patients required amputation in the particular battle quoted by Gray.[7]

The drastic reduction in morbidity and mortality may not have been solely due to the use of the Thomas splint, since methods of evacuation and treatment had also improved, although the splint undoubtedly played a huge role.[8] Teams of three stretcher bearers, who were themselves often mortally wounded, were required to apply the splint swiftly to casualties lying in 'no-man's land', under enemy fire and at night. To prepare for this task they were trained to apply the splint blind-fold by numbers.[9] To increase speed of use in the field the limb was placed in the splint without removal of clothes or boots (Fig. 4) and traction was applied by a clove hitch over the boot or a special clip into the heel of the boot, known as Tapson's sole clip.

One disadvantage of the use of a clove hitch in this way was the risk of ischaemia of the foot if traction was applied too vigorously or for too long. In order to increase comfort during transport the splint was suspended clear of the stretcher by the application of suspension bars (Fig. 4). Later, a knee flexion piece was added to allow adequate definitive treatment of more distal femoral fractures by the splint.

The Thomas splint proved to be extremely versatile and a smaller modified version was also used for immobilising fractures of the humerus and of the forearm around the elbow, with the arm held in extension[7] (Fig. 5).

In North Africa during the Second World War the Thomas splint began to be used in a different form by the British and Australian forces. Casualties were evacuated from forward field hospitals by ambulance, travelling over rough desert terrain. Even with the damaged limb immobilised in a Thomas splint jolting and jarring of the limb still occurred, making these long journeys agonising for the injured soldiers. The solution to this problem was to place the limb in traction in the Thomas splint as normal, apply padding, and then wrap the splint and limb in plaster-of-Paris. This achieved excellent immobilisation and allowed the casualties to be transported more comfortably. There

Fig. 5

Diagram showing the modified Thomas splint used for treating fractures of the upper limb, (from *Early treatment of war wounds* by Gray[7] (1919) by permission of Oxford University Press).

were several different arrangements of this modification, which became known as the 'Tobruk splint', named after the siege of Tobruk in 1941.[10] It was favoured by British surgeons over the plaster-of-Paris spica because it was quicker to apply and required less plaster and water, two resources which were in short supply in North Africa. This splint is still used today in the treatment of some femoral fractures in children.

The Thomas splint has also continued to prove its value in armed conflict. It has found an extended use in the modern treatment of battlefield injury, proving useful in the management of open and closed fractures of the femur in casualties who could not be moved for political or logistical reasons. The report of the Royal Army Medical Corps on the first ten days of the 2003 Gulf conflict found the Thomas splint to be an essential tool, particularly in the management of ballistic injuries.[11] It is of advantage when treating fractures which are complicated by open soft-tissue injuries since the wounds can be reviewed on a daily basis and managed accordingly. This would not be the case if the leg were fully enclosed in a cast.

The fundamental principles of the Thomas splint which are that it is non-invasive, easily applied and has few complications, make it useful in settings other than in hospital. Pre-hospital practitioners often have to deal with patients with open or closed femoral fractures. These patients require splintage to prevent haemorrhage, to allow analgesia and to facilitate transport. Various splints which allow traction have evolved from the original design.[12] The splint remains an essential itemin the initial management of fractures of the shaft of the femur which owes much to the ingenuity and simplicity of the original design.

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

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