THE ROBERT JONES BANDAGE

JAMES DAVID BRODELL, DAVID L. AXON, C. McCOLLISTER EVARTS

From the University of Rochester, New York

A bulky compression dressing (the Robert Jones bandage) is often used by orthopaedic surgeons. We have reviewed its history and monitored intramuscular compartment pressure under it after total knee replacement. We found that it increased compartment pressure and helped to reduce bleeding, tissue oedema and the size of effusions and haemarthroses.

The Robert Jones dressing is a thick, well-padded knee bandage often used after trauma and elective operations. Because it provides firm, evenly distributed pressure, it is thought to minimise oedema and bleeding in traumatised tissues, but there is little in the orthopaedic literature about the actual components of the dressing or how it works.

In the 1800s and 1900s, several English surgeons reported improved circulation in the leg, better wound healing and decreased wound drainage after external pressure (Trueta 1943). In his *Handbook of orthopaedic surgery*, Shands (1937) illustrated a knee dressing made of several layers of stockinette, cotton wool and elastic cloth (Fig. 1) which he recommended for use after injury or operation. In 1943 Trueta also advocated compression and accomplished this either by applying plaster directly to the skin or by using a layer of sponge rubber between the wound and the plaster. Smillie (1978) advocated the use of a compression bandage after meniscectomy. None of these authors, however, credited Robert Jones as the originator of such a bandage.

Charnley (1950) was the first to write of the "Robert Jones bandage", saying that it "often does not receive the attention which its importance merits". Pointing out that, for the majority of knee injuries, it was "infinitely better than any form of plaster cast", Charnley provides the most complete description of the bandage. More recently, Harkness (1975) warned against the use of casts which could become tight and thus recommended "a Jones dressing ... where swelling is expected". The term "compressive bandage" was discouraged for fear that surgeons would apply it too tightly.

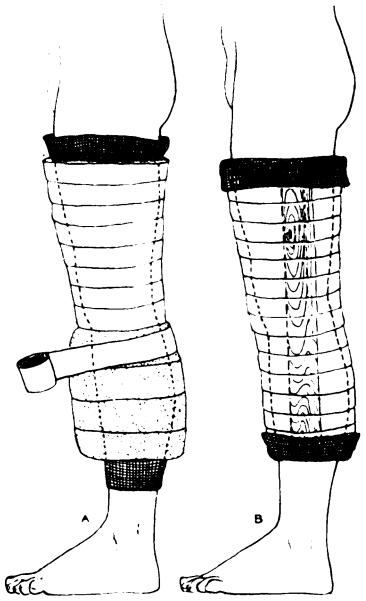

Fig. 1
The compression dressing of Shands 1937.

Specific references to the bandage are rare in the writings of Robert Jones and his pupils. Watson-Jones (1957) recalls the incredibly long daily lists of operations performed by Robert Jones and refers to a "pressure crêpe bandage over copious wool dressing" which was applied to the knee of a patient after meniscectomy. T. P. McMurray was reported by Roaf (personal communication, 1983) to have said that Jones routinely used bulky compression bandages.

Because the references to the Robert Jones bandage are so sketchy, accounts of the components of the bandage and the technique of application have varied from author to author. Charnley (1950) described it as consisting of "three layers of wool and three layers of domette bandage. The layers are put on gently but firmly and the whole bandage extends some six inches above and below

J. D. Brodell, MD
D. L. Axon, MD, Chief Orthopaedic Resident
C. M. Evarts, MD, Professor of Orthopaedics, Chairman, Department of Orthopaedics
The University of Rochester School of Medicine and Dentistry, 601 Elmwood Avenue, Rochester, New York 14642, USA.
Requests for reprints should be sent to Dr J. D. Brodell, 2614 East Market Street, Warren, Ohio 44483, USA.

0301 620X/86/5166 $2.00

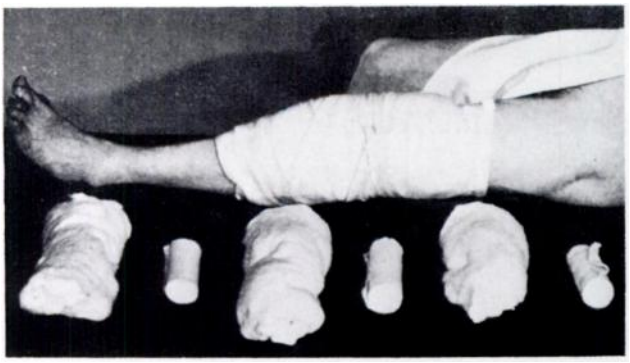

Fig. 2

The Robert Jones compression dressing used by Charnley 1950.

the joint and attains a thickness of about two inches" (Fig. 2). Smillie's version (1978) is similar while Harkness (1975) used thick cotton padding and elastic bandages. Plaster splints were added if additional support was required; this technique is currently used at the University of Rochester.

There has been little research on the effect of external pressure on soft-tissue swelling. The most significant work was by Matsen and Krugmire (1974) who studied tibial fractures in the rabbit and concluded that "externally applied pressure can limit swelling but the pressure must be uniform and controlled so it does not have adverse h[a]emodynamic effects. Most pressure dressings currently in use have the undesirable property of applying more pressure as the volume of the limb increases."

Considerably more research has been aimed at the effect of externally applied pressure on limb haemodynamics. Yet there is still controversy as to whether venous outflow is improved (thus helping to prevent deep thrombosis) or whether basic perfusion of the limb is impaired (Sabri, Roberts and Cotton 1971). Most authors agree that oedema formation is detrimental to limb perfusion, and it is known that skin is more sensitive to externally applied pressure than muscle; the critical closing pressure of muscle arterioles is approximately 50 mmHg and of those in skin approximately 30 mmHg (Ogata and Whiteside 1982). These figures are consistent with those reported by Whitesides et al. (1975) in their study of compartment syndromes.

Most of the support for the use of compression dressings has arisen from observation and dogma. Following his teacher Hugh Owen Thomas, who emphasised elevation and immobilisation of an extremity, Robert Jones believed that oedema increased tension within a wound, thereby delaying wound healing. He and others also taught that swelling in and around joints contributed to long-term stiffness (Jones 1921; Joynt 1921). Trueta (1943) agreed with these observations and believed that gentle and persistent pressure applied to a wound would promote "healthy granulations (and) only a small amount of discharge". Recognising that a bulky compression dressing provides firm support while allowing some joint movement, Charnley (1950) and Smillie (1978) both suggested that the resilient bandage could regulate the amount of applied pressure first by accommodating swelling and then by continuing to apply gentle pressure with a diminishing effusion.

However, not all clinicians share this enthusiasm for the bandage. The most frequent criticism centres on the question of how much pressure is applied under the dressing and how long it is maintained. At an AO/ASIF conference (1983) Rosen and Schatzker reported that they used pressure transducers under such bandages and that pressures stayed elevated for only five minutes or less. Smillie (1978) however, reported that pressure was maintained for longer periods of time – "the compression exerted when applied ... varies between 40 mm and 50 mm of mercury, depending on the technique of the surgeon, but falls to a level of 2–10 mm of mercury within 48 hrs."

MATERIAL AND METHODS

In an attempt to resolve whether the Jones dressing could generate and maintain pressure, the anterolateral muscle compartment pressures in nine patients who had just undergone total knee arthroplasty were monitored. Immediately after wound closure, a slit catheter was placed in the compartment 10 cm below the joint line (Whitesides et al. 1975). Pressures were recorded by an interstitial pressure monitor (Howmedica); the machine was carefully calibrated and the instantaneous reaction to pressure changes was confirmed by pressing on the muscle. In each case, the tourniquet was deflated and haemostasis was assured before wound closure. Tourniquet times did not exceed 1.5 hours.

Sterile gauze pads were placed over the wound followed by thick cotton wool applied from a roll so that each layer overlapped the previous one by one-half at each turn; pads and cotton wool together provided a thickness of approximately two inches. Another layer of cotton wool applied from a roll was then covered by an elastic bandage. This final elastic layer was pulled quite snugly with more tension distally than proximally in an effort to promote venous drainage. The entire limb was bandaged.

RESULTS

In the first two patients, measurements were made at 15-minute intervals to determine whether pressure would fall rapidly but, in both cases, it was well maintained after four hours (Table I). The dressing was then removed to make sure that the elevated pressure was not due to post-traumatic or post-tourniquet oedema, and in both cases the compartment pressure immediately decreased.

In the remaining seven patients we recorded pressures every two hours for 24 hours. The results are given in Table II. At or about 24 hours the dressings were

Table I. Pressure measurements in two patients: this was well maintained at four hours

Time after skin closure	Compartment pressure (*mmHg*) Case 1	Case 2
Catheter in place	13	16
Dressing in place	45	51
15 min	40	46
30 min	33	40
45 min	32	31
1 hour	31	31
1 hr 15 min	30	29
1 hr 30 min	30	31
2 hours	29	29
2 hr 30 min	28	30
3 hours	32	29
4 hours	29	26
Dressing removed	9	14

Table II. Pressures recorded in the remaining seven patients

Time after skin closure	Compartment pressure (*mmHg*) Case 3	4	5	6	7	8	9
Catheter in place	17	6	4	7	5	6	3
Dressing in place	54	76	43	67	51	54	41
15 min		55	42	54	40	36	41
30 min			42	49	40	36	34
45 min			42	46	38	36	36
1 hr	32	49	42	39	37	36	34
2 hrs	29	38	40	40	40	37	32
3 hrs		38		40			
4 hrs	28	36	42	40	36	35	32
6 hrs	30	30	40	44	33	32	33
8 hrs	29	28	37	41	32	30	32
10 hrs	27	30	34	41	33	33	31
12 hrs	31	32	37	41	35	31	29
14 hrs	30	30	35	42	31	34	29
16 hrs	30	31	36	43	32	34	30
				6			
18 hrs	26	33	40	22	31	35	28
20 hrs	27	32	40	22	33	34	28
22 hrs	27	31	39	20	32	36	36
24 hrs	25	4	38	19	33	34	26
24 hrs	10		19		5		6
26 hrs	33			21		35	
28 hrs				22			
				2			

dressing removed
dressing replaced

removed and, once again, in each case the compartment pressure immediately decreased. In three patients (Cases 3, 4 and 6) the same cotton and elastic bandage was reapplied (each at different times); this caused the compartment pressures to increase again but to less than the original levels.

DISCUSSION

The Robert Jones dressing has enjoyed widespread popularity as a postoperative or post-traumatic bandage. Although its value has been attested to from clinical observation, little research has been done to support the contention that externally applied pressure reduces post-traumatic oedema. Unquestionably, the prevention of swelling is important; what has been challenged is the efficacy of the Robert Jones bandage in achieving and maintaining significant external pressure.

Some surgeons report that, while the initial pressure under this type of dressing may be satisfactory, this falls so rapidly as to render the bandage useless. Supporters of the bandage have suggested that pressure may be maintained for longer periods of time (Smillie 1978). Our results show that it can generate and maintain external compression of the soft tissues for at least 24 hours. In fact, an initial "snug" application may occasionally send pressures to a value which might theoretically risk the development of a compartment syndrome; however, in our study these high pressures fell to a safer 30 mmHg range after 15 to 30 minutes. Decreases in pressure we believe were due to compression of the cotton wool underneath the elastic bandage and perhaps due to fatiguing of the bandage itself; this may explain the relatively lower pressures achieved when the same bandage and cotton wool were re-used for reapplication of the dressing.

Conclusion. A traumatised limb should have soft-tissue stabilisation as well as bony stabilisation. By supporting the soft tissues, the Robert Jones dressing relieves pain and may facilitate healing. Used properly, compression bandages diminish oedema of the extremity and limit effusions and haemarthroses; they therefore have wide clinical applications. By favourably altering the hydrostatic gradient in local tissues, they decrease capillary oozing; and by maintaining the pressure gradient they help to prevent swelling. The Robert Jones bandage is not, however, a substitute for good operative technique, which must include meticulous control of bleeding, and it does not absolve the surgeon from his responsibility for performing frequent checks on circulation and neurological integrity.

Despite the lack of historical documentation, there can be little doubt that the modern application of the compression dressing has grown from the principles advocated by Sir Robert Jones and is another example of his profound influence on orthopaedics.

REFERENCES

Charnley J. The treatment of fracture without plaster of Paris. *Closed treatment of common fractures.* Edinburgh etc: E & S Livingstone, 1950:28–9.

Gibson MJ, Barnes MR, Allen MJ, Chan RNW. Weakness of foot dorsiflexion and changes in compartment pressures after tibial osteotomy. *J Bone Joint Surg [Br]* 1986;68 B:471–5.

Harkness JW. Principles of fractures and dislocations. In: Rockwood CA, Green DP, eds. *Fractures.* Philadelphia: JB Lippincott, 1975: 46–8.

Jones R, ed. *Orthopaedic surgery of injuries.* London: Oxford University Press, 1921.

Journal of Bone and Joint Surgery. A chronological list of Sir Robert Jones' contribution to the surgical literature. *J Bone Joint Surg [Br]* 1957;39 B:212–7.

Joynt RL. Plain metals splints. In: Jones R, ed. *Orthopaedic surgery of injuries.* London: Oxford University Press, 1921:459–87.

Matsen FA III, Krugmire RB Jr. The effect of externally applied pressure on post-fracture swelling. *J Bone Joint Surg [Am]* 1974;56–A: 1586–91.

Ogata K, Whiteside LA. Effects of external compression on blood flow to muscle and skin. *Clin Orthop* 1982;168:105–7.

Sabri S, Roberts VC, Cotton LT. Effects of externally applied pressure on the haemodynamics of the lower limb. *Br Med J* 1971;iii: 503–8.

Shands AR. *Handbook of orthopaedic surgery.* St Louis: CV Mosby, 1937:418.

Smillie IS. *Injuries of the knee joint.* Edinburgh etc: Churchill Livingstone, 1978:171–3.

Trueta J. The effect of pressure on wounds. *The principles and practice of war surgery with reference to the biological method of treatment of wounds and fractures.* London: Hamish Hamilton Medical Books and William Heinemann Medical Books Ltd, 1943:32–3.

Watson-Jones R. Robert Jones 1857–1933. *J Bone Joint Surg [Br]* 1957; 39–B:179–217.

Whitesides TE Jr, Haney TC, Morimoto K, Harada H. Tissue pressure measurements as a determinant for the need of fasciotomy. *Clin Orthop* 1975;113:43–51.