Other Selected Clinical Literature 1998 - 2008

Abstracts

Tuncali B, Karci A, Tuncali BE, et al. A new method for estimating arterial occlusion pressure in optimizing pneumatic tourniquet inflation pressure. Anesth Analg 2006 Jun;102(6):1752-7.

Product Identifier:
Pneumatic Tourniquets
Abstract: The authors studied the relationship between tourniquet inflation pressure (TIP) and pressure in the underlying soft tissue in 30 anesthetized adult patients undergoing upper- and lower-limb surgery using a pneumatic tourniquet. In all patients, tissue pressure under the tourniquet (TPUT) ranged from 9 to 16 mm Hg when TIP was 0 mm Hg (basal TPUT). Soft-tissue pressure, however, was consistently less than applied TIP at 100, 200, and 300 mm Hg in all patients. The pressure difference increased as the extremity size increased. Data plotting demonstrated that the relationship between TPUT values and extremity circumference was nonlinear in the arm and leg. The authors created an equation to develop a regression model of TPUT expressed as a percentage of TIP versus limb circumference. The authors also created 2 equations to determine arterial occlusion pressure (AOP) to add a safety margin for obtaining minimal TPUT to occlude blood. The authors state that their new equation, which is based on systolic blood pressure (SBP) and extremity circumference, may be a clinically practical alternative to the AOP determination method. The authors add that when constant TIP is used during surgery, their equation demonstrates that SBP should be kept as low as possible and maintained stable to reach minimal inflation pressures. The authors state that they are using their equation to develop a pneumatic tourniquet that exhibits a beat-to-beat response to SBP. The authors conclude that soft TPUT cuff values are lower than applied TIP because of a tissue-padding effect observed in anesthetized adults and that their AOP estimation method is a simple, rapid alternative to the AOP determination method.
Source: Tuncali B, Karci A, Tuncali BE, et al. A new method for estimating arterial occlusion pressure in optimizing pneumatic tourniquet inflation pressure. *Anesth Analg* 2006 Jun;102(6):1752-7.

Ishii Y, Matsuda Y. Effect of the timing of tourniquet release on perioperative blood loss associated with cementless total knee arthroplasty. J Arthroplasty 2005 Dec;20(8):977-83.

Product Identifier:
(1) New Jersey Low-Contact-Stress Total Knee Systems; (2) 86 × 10 cm Tourniquet
Cuffs; (3) Model MT-720 Tourniquet Systems
Manufacturer: (1) DePuy A Johnson & Johnson Co [305461], 700 Orthopaedic Dr
PO Box 988, Warsaw IN 46581-0988; (2 and 3) Mizuho Ikakogyo Co Ltd [288805], 3-29-10
Hongo Bunkyo-ku, Tokyo 113, Japan
Abstract: The authors evaluated the efficacy of tourniquet release before compared to after wound closure to prevent perioperative blood loss during implantation of New Jersey low-contact-stress total knee systems in 60 knees of 55 patients. The tourniquet was released before wound closure in 30 knees of 29 patients and after wound closure in 30 knees of 26 patients. No complications occurred during or after surgery. 4 patients in the before-closure group and 2 patients in the after-closure group had hemoglobin levels <8.0 g/dL but exhibited no symptoms of anemia. No patient required blood transfusion. Duration of tourniquet application was 48 ±9 min in the before-closure group and 66 ±12 min in the after-closure group. Duration of surgery was 71 ±9 min in the before-closure group and 60 ±11 min in the after-closure group. Mean total blood loss for all knees was 819 mL. Total blood loss in the before-closure group was 906 ±238 mL. Total blood loss in the after-closure group was 731 ±332 mL. Red blood cell counts, hemoglobin levels, and hematocrit values were lower in both groups at 1 week postoperatively than they were preoperatively but returned to normal by 3 months. The authors conclude that tourniquets should be released after wound closure during implantation of New Jersey low-contact-stress total knee systems and that a compressive dressing should be applied to limit or reduce perioperative blood loss.
Source: Ishii Y, Matsuda Y. Effect of the timing of tourniquet release on perioperative blood loss associated with cementless total knee arthroplasty. *J Arthroplasty* 2005 Dec;20(8):977-83.

Katsumata S, Nagashima M, Kato K, et al. Changes in coagulation-fibrinolysis marker and neutrophil elastase following the use of tourniquet during total knee arthroplasty and the influence of neutrophil elastase on thromboembolism. Acta Anaesthesiol Scand 2005 Apr;49(4):510-6.

Product Identifier:
(1) Total Knee Prostheses; (2) Tourniquets
Abstract: The authors evaluated the changes in coagulation-fibrinolysis marker and neutrophil elastase (NE) levels following use of a tourniquet during implantation of total knee prostheses in 50 patients and the subsequent effect on development of deep vein thrombosis (DVT) and pulmonary thromboembolism (PTE). Total knee arthroplasty (TKA) was performed with a tourniquet in 25 patients and without a tourniquet in the remaining 25 patients. Mean thrombin-antithrombin III (TAT) complex levels were significantly higher in the tourniquet group than in the nontourniquet group immediately after surgery and on postoperative day (POD) 1. In the tourniquet group, maximum mean TAT complex levels occurred immediately after surgery, with an approximately 7-fold difference between the groups. Rates of increase in mean D-dimer levels were higher in the tourniquet group than in the nontourniquet group immediately after surgery and on PODs 1, 3, 7, 14, and 21. In the tourniquet group, maximum mean D-dimer levels occurred on POD 1, with more than a 3-fold difference between groups. Rate of increase in mean NE was significantly higher in the tourniquet group than in the nontourniquet group on PODs 1 and 3. In the tourniquet group, maximum NE levels occurred on POD 1, with an approximately 8-fold difference between groups. In a mouse

model of PTE, the authors investigated the effects of adenosine diphosphate (ADP) and NE on lung tissue and mortality caused by PTE. PTE mortality rates in mice increased from 43% to 67% when human NE was administered together with 40 mg/mL ADP at 0.7 mL/100 g body weight. Mortality rate in mice that received 1 injection of human NE was 0%. Mice that received ADP and NE demonstrated diffuse, extensive accumulation of platelets and fibrin in alveolar capillaries and other microvessels. The authors conclude that use of a tourniquet during TKA may promote local release of NE together with reactive-O_2 derivatives, contributing to the development of DVT, PTE, and tissue injury.
Source: Katsumata S, Nagashima M, Kato K, et al. Changes in coagulation-fibrinolysis marker and neutrophil elastase following the use of tourniquet during total knee arthroplasty and the influence of neutrophil elastase on thromboembolism. *Acta Anaesthesiol Scand* 2005 Apr;49(4):510-6.
Comment: The conclusion presented by the authors—that the use of a tourniquet may promote local release of NE—does not take into account several confounding experimental factors and may be incorrect. The tourniquet group and the nontourniquet group were treated at different hospitals. Additionally, the operative time was more than 30 min (50%) shorter and blood loss was greater by about 100 mL (15%) in the tourniquet group. The authors do not take into account that different operative locations, shorter operative time, or greater blood loss can affect the measured increase in NE levels. As a result, the conclusion reached by the authors may not be complete. Additional testing investigating the confounding experimental factors should be performed to confirm the conclusions of this study before clinical practices are changed based on this data.

Iwama H, Kaneko T, Ohmizo H, et al. Circulatory, respiratory and metabolic changes after thigh tourniquet release in combined epidural-propofol anaesthesia with preservation of spontaneous respiration. *Anaesthesia* 2002 Jun;57(6):588-92.

Product Identifier:
(1) Pneumatic Thigh Tourniquets; (2) Laryngeal Mask Airways
Abstract: The authors examined circulatory, respiratory, and metabolic changes during application and 1, 3, 5, 15, and 30 min after release of the pneumatic thigh tourniquet in combined epidural-propofol anesthesia with preservation of spontaneous respiration via the laryngeal mask airway (LMA) in 12 elderly patients. Systolic and diastolic arterial blood pressures gradually increased during tourniquet application but decreased following tourniquet release. Heart rate increased 1 min, 3 min, and 5 min after tourniquet release, and respiratory rate increased 1 min after tourniquet release. PaO_2 decreased and $PaCO_2$ increased 1 min after tourniquet release but then quickly decreased. Arterial blood pH decreased 1 min and 3 min after tourniquet release, and base excess decreased 1 min, 3 min, and 5 min after tourniquet release. HCO_{3^-} levels did not change. Potassium levels increased 1 min, 3 min, 5 min, and 15 min after tourniquet release. Lactate levels increased at all times after tourniquet release. The authors conclude that use of the pneumatic thigh tourniquet in combined epidural-propofol anesthesia with preservation of spontaneous respiration via the LMA reveals that while the recovery of respiratory and metabolic variables after tourniquet release is fast, recovery of circulation is slow. They add that these characteristics are identical to those under conscious regional anesthesia with spontaneous respiration and that spontaneous respiration in this anesthetic regimen has a similar respiratory capacity to that of conscious spontaneous respiration.
Source: Iwama H, Kaneko T, Ohmizo H, et al. Circulatory, respiratory and metabolic changes after thigh tourniquet release in combined epidural-propofol anaesthesia with preservation of spontaneous respiration. *Anaesthesia* 2002 Jun;57(6):588-92.

Giannoudis PV, Snowden S, Matthews SJ, et al. Friction burns within the tibia during reaming: are they affected by the use of a tourniquet? *J Bone Joint Surg Br* 2002 May;84(4):492-6.

Product Identifier:
(1) AO Reamers; (2) Tourniquets
Manufacturer: (1) Synthes AG Chur [170958], Grabenstrasse 15, CH-7002 Chur, Switzerland; (2) Manufacturer not identified in article
Abstract: The authors prospectively evaluated the temperature rise and blood loss during reaming of the tibia with and without use of a tourniquet in 34 adult patients with isolated fracture of the diaphysis of the tibia. The median injury severity score was 10. Fractures were stabilized without a tourniquet in 18 patients and with a tourniquet at a pressure of 300 mm Hg in 16 patients. Hemoglobin dropped from 14.3 ±1.02 g/dL to 11.5 ±1.04 g/dL in patients without tourniquets and from 14 ±1 g/dL to 12.7 ±1.3 g/dL in patients with tourniquets. Mean initial tibial temperature before reaming was 35.6°C. Temperatures rose to between 36.3° and 51.6°C during reaming. The largest reamers caused the highest temperatures. Temperature rose most rapidly in the smallest diameters of the medullary canal, but this rise was transient. Temperature elevation and reamer size were directly correlated. In all cases, fractures progressed to union within a mean of 21 weeks. The authors conclude that tibia reaming results in a transient generation of temperature but that tourniquet use and reaming to 1.5 mm above the required diameter of the nail appear safe.
Source: Giannoudis PV, Snowden S, Matthews SJ, et al. Friction burns within the tibia during reaming: are they affected by the use of a tourniquet? *J Bone Joint Surg Br* 2002 May;84(4):492-6.

Bruce AS, Getty CJ, Beard JD. The effect of the ankle brachial pressure index and the use of a tourniquet upon the outcome of total knee replacement. *J Arthroplasty* 2002 Apr;17(3):312-4.

Product Identifier:
(1) Standard Aneroid Sphygmomanometers; (2) Super Dopplex II Handheld Doppler Machines with 8 MHz Probes; (3) Tourniquets
Manufacturer: (1 and 3) Manufacturer not identified in article; (2) Huntleigh Diagnostics Ltd Div Huntleigh Healthcare Inc [333648], 35 Portmanmoor Rd, Cardiff South Glamorgan CF24 5HN, Wales
Abstract: The authors determined whether total knee arthroplasty (TKA) was safe in patients without foot pulses or with an abnormal ankle brachial pressure index (ABPI), as measured by handheld Doppler machines, and evaluated the effort of tourniquet use on TKA outcomes. 73 patients were

included in the study: 27 patients underwent simultaneous bilateral TKA, and 46 patients underwent unilateral TKA. On palpation, 24 patients were missing the dorsalis pedis pulse and 30 patients were missing the posterior tibial pulse. All but 4 impalpable pulses were heard with the Doppler probe, but 35 limbs had an abnormal preoperative ABPI. Tourniquets were
used on 92 knees perioperatively, with a mean tourniquet time of 1.8 hr. Preoperatively, brachial pressure was 160 mm Hg, dorsalis pedis pressure was 181 mm Hg, posterior tibial pressure was 179 mm Hg, dorsalis pedis ABPI was 1.12, and posterior tibial ABPI was 1.13. Postoperatively, brachial pressure was 145 mm Hg, dorsalis pedis pressure was 167 mm Hg, posterior tibial pressure was 165 mm Hg, dorsalis pedis ABPI was 1.19, and posterior tibial ABPI was 1.15. Overall, there was no detrimental effect of TKA. The authors conclude that handheld Doppler machines detected 98% of clinically impalpable foot pulses and that TKA with a tourniquet is
safe in patients with impalpable foot pulses as long as the femoral pulse is palpable and there are no signs of ulceration or rest pain.
Source: Bruce AS, Getty CJ, Beard JD. The effect of the ankle brachial pressure index and the use of a tourniquet upon the outcome of total knee replacement. *J Arthroplasty* 2002 Apr;17(3):312-4.

Casey V, Griffin S, O'Brien SB. An investigation of the hammocking effect associated with interface pressure measurements using pneumatic tourniquet cuffs. *Med Eng Phys* 2001 Sep;23(7):511-7.

Product Identifier:
(1) Pneumatic Tourniquet Cuffs; (2) Accoson Mercury Sphygmomanometers; (3) Generic Aluminum Disk Interface Pressure Sensors; (4) LPM 530 Miniature Load Cells
Manufacturer: (1) Zimmer Inc [102165], PO Box 708, Warsaw IN 46581-0708; (2 through 4) Manufacturer not identified in article
Abstract: The authors report the use of a 10 mm diameter, 5 mm high aluminum disk interface pressure sensor; a miniature load cell; and a 10.4 cm wide, 47.5 cm long tourniquet cuff connected to a mercury sphygmomanometer to investigate the cuff-sensor interaction and the hammocking effect associated with interface pressure measurements. The sensor-indicated pressure was monitored at 0 to 3 mm sensor heights and 0 to 40 kPa cuff inflation pressures. The authors state that the sensor pressure was greater than the tourniquet pressure at all sensor heights, including at zero height. Hammocking had a profound effect on sensor-indicated interface pressure, with a tendency for the sensor pressure to saturate at high tourniquet-applied pressures. The authors state that membrane tension had a significant impact on the degree of hammocking. The ratio of pressure to tension in the membrane was not constant, except for tight-cuff-wrap conditions. The tension was not a simple linear function of the applied pressure for such conditions. Hammocking was significantly reduced by placing a Teflon guard ring around the sensor. The authors conclude that use of a 10 mm diameter, 5 mm high aluminum disk interface pressure sensor; a miniature load cell; and a 10.4 cm wide, 47.5 cm long tourniquet cuff connected to a mercury sphygmomanometer is not appropriate for life-critical surgeries.
Source: Casey V, Griffin S, O'Brien SB. An investigation of the hammocking effect associated with interface pressure measurements using pneumatic tourniquet cuffs. *Med Eng Phys* 2001 Sep;23(7):511-7.

Hirota K, Hashimoto H, Kabara S, et al. The relationship between pneumatic tourniquet time and the amount of pulmonary emboli in patients undergoing knee arthroscopic surgeries. *Anesth Analg* 2001 Sep;93(3):776-80.

Product Identifier:
Pneumatic Tourniquets
Abstract: The authors report the use of pneumatic tourniquets and transesophageal echocardiography (TEE) to determine the relationship between pneumatic tourniquet time (Ttq) and the number of pulmonary emboli in 30 arthroscopic-knee-surgery patients. The authors state that TEE detected emboli in all patients. The peak amount of emboli (Ae) occurred 40 to 50 sec after tourniquet release. The authors further state that the Ae depended on the Ttq, with a significant correlation between the 2 variables. After tourniquet release, systolic and diastolic blood pressures decreased and heart rates increased, but the hemodynamic changes were within a clinically acceptable range. No patients demonstrated symptoms of pulmonary embolism. The authors state that increased end-tidal CO_2 after tourniquet release was Ttq dependent and saturable. The authors conclude that acute pulmonary embolism can occur within 1 min of pneumatic tourniquet release and that the Ae is dependent on the duration of tourniquet inflation.
Source: Hirota K, Hashimoto H, Kabara S, et al. The relationship between pneumatic tourniquet time and the amount of pulmonary emboli in patients undergoing knee arthroscopic surgeries. *Anesth Analg* 2001 Sep;93(3):776-80.

Tetro AM, Rudan JF. The effects of a pneumatic tourniquet on blood loss in total knee arthroplasty. *Can J Surg* 2001 Feb;44(1):33-8.

Product Identifier:
(1) Pneumatic Tourniquets; Total Knee Prostheses: (2) AMK, (3) Omnifit 7000, (4) Press-Fit Condylar
Manufacturer: (1) Manufacturer not identified in article; (2) DePuy A Johnson & Johnson Co [305461], 700 Orthopaedic Dr PO Box 988, Warsaw IN 46580; (3) Stryker Howmedica Osteonics Div Stryker Corp [361275], 59 Rt 17 S, Allendale NJ 07401; (4) Johnson & Johnson Corp [150059], One Johnson & Johnson Plaza, New Brunswick NJ 08933
Abstract: The authors evaluated the effects of pneumatic tourniquets on the reduction of blood loss in total knee arthroplasty (TKA) in 63 patients. 33 patients underwent TKA with the tourniquet, and 30 patients underwent TKA without the tourniquet. Intraoperative blood loss in the tourniquet and nontourniquet group was 148 mL and 295 mL, respectively. Hemovac drainage blood loss was 507 in the tourniquet group and 449 in the nontourniquet group. Total calculated blood loss was 1,792 mL in the tourniquet group and 1,499 mL in the nontourniquet group. Mean pre- and postoperative hemoglobin levels did not significantly differ between groups. Male patients tended to lose more blood than female patients. Mean pre- and postoperative hemoglobin levels were 140 g/L and 102 g/L, respectively, in men and 128 g/L and 88 g/L, respectively, in women. 10 tourniquet and 6 nontourniquet patients required transfusions. The mean amount of transfused blood administered in the tourniquet group and the nontourniquet group was 1.7 and

1.5 units, respectively. Mean operative time in the tourniquet and nontourniquet groups was 83 and 81 min, respectively. 11 complications in the tourniquet group included 4 cases of superficial wound infection, 1 case of skin blistering, and 6 cases of significant wound hematoma. In the nontourniquet group, there was 1 superficial wound infection, 3 hematomas, and 1 gastrointestinal hemorrhage. The authors conclude that the reduced intraoperative blood loss with pneumatic tourniquets is offset by significantly greater overall blood loss and higher complication rates, and they find no data to support the continued use of tourniquets to control blood loss.
Source: Tetro AM, Rudan JF. The effects of a pneumatic tourniquet on blood loss in total knee arthroplasty. *Can J Surg* 2001 Feb;44(1):33-8.

Tham CH, Lim BH. A modification of the technique for intravenous regional blockade for hand surgery. *J Hand Surg {Br}* 2000 Dec;25(6):575-7.

Product Identifier:
Tourniquets: (1) Automated Double-Cuffed Pneumatic; (2) Esmarch Pressure Bandages
Abstract: The authors prospectively studied a modified intravenous regional anesthesia (IVRA) technique involving a temporary third tourniquet on the forearm during lignocaine injection in 18 patients who underwent minor hand surgery. The forearm tourniquet was placed after application and inflation of an automated, double-cuffed, pneumatic tourniquet and removed before exsanguination with an Esmarch bandage. Mean tourniquet time was 41 min. The disadvantage was a burning sensation during the initial lignocaine introduction, avoided by slowing the rate of lignocaine introduction. Additional anesthetic block was not required during any of
the procedures. No patient experienced pain, and all patients tolerated the tourniquet without significant discomfort. The presence of blood in the operative field was ranked as excellent with a bloodless field in 6 patients, good with easily controlled slight oozing in 10 patients, and satisfactory with suction required in 2 patients. No surgery was compromised because of blood in the operative field. No patient required reexsanguination. There was 1 case of postoperative giddiness that resolved within 30 min, and there were no other anesthetic complications. The authors conclude that the modified IVRA technique using a temporary third forearm tourniquet during
lignocaine injection results in quick and dense anesthesia in the hand, easier and more comfortable Esmarch bandage application, and fewer adverse effects.
Source: Tham CH, Lim BH. A modification of the technique for intravenous
regional blockade for hand surgery. *J Hand Surg {Br}* 2000 Dec;25(6):575-7.

Paris-Seeley NJ, McEwen JA, Romilly DP, et al. A compliance-independent pressure transducer for biomedical device-tissue interfaces. *Biomed Instrum Technol* 2000 Nov-Dec;34(6):423-31.

Product Identifier:
24 mm × 3 mm Stainless Steel Compliance-Independent Interface Pressure Transducers
Abstract: The authors report the development of a fourth-generation prototype 24 mm diameter × 3 mm deep stainless steel compliance-independent pressure transducer with a Mylar film diaphragm for biomedical device-tissue interfaces. The authors state that the transducer operates by balancing interface pressure on a diaphragm with an equal and opposite fluid pressure. The fluid pressure was equivalent to the average applied interface pressure if the diaphragm was maintained in the original, unloaded position. A strain gauge was bonded to the underside of the diaphragm and connected to a Wheatstone bridge circuit to monitor the diaphragm position. The authors state that when evaluated in the calibration system, the transducer fulfilled many of the previously determined optimal specifications. When a layer of ultrasonic gel was applied to the diaphragm and a layer of latex was applied to the gel, the developed interface pressure transducer operated optimally in the surgical retraction application. The authors conclude that the developed transducer worked well under the center of a pneumatic tourniquet cuff, although the transducer output was adversely affected when measured under the edge of a cuff.
Source: Paris-Seeley NJ, McEwen JA, Romilly DP, et al. A compliance-independent pressure transducer for biomedical device-tissue interfaces. *Biomed Instrum Technol* 2000 Nov-Dec;34(6):423-31.

Clarke MT, Longstaff L, Edwards D, et al. Tourniquet-induced wound hypoxia after total knee replacement. *J Bone Joint Surg Br* 2001 Jan;83(1):40-4.

Product Identifier:
(1) 11.5 × 9.0 cm Thigh Tourniquets; (2) Cemented Insall-Burstein II Total Knee
Replacement Prostheses
Manufacturer: (1) DePuy International Ltd [195066], St Anthony's Rd, Leeds West Yorkshire LS11 8DT, England; (2) Zimmer Inc [102165], PO Box 708, Warsaw IN 46581-0708
Abstract: The authors investigated whether use of 11.5 × 9.0 cm thigh tourniquets influenced postoperative wound hypoxia after total knee replacement (TKR) with a cemented prosthesis in 31 patients. 1 group received no tourniquet (NT), and a second and third group received a tourniquet applied at 125 mm Hg (LT) and 250 mm Hg (HT), respectively, above mean anesthetic arterial blood pressure. The mean preoperative truncal transcutaneous oxygen pressure ($ptcO_2$) was 8.7 kPa. Medial wound flap tissue oxygenation readings demonstrated that the maximum mean oxygenation reduction during the first 3 days was 1.38 kPa $ptcO_2$ in the NT group, 2.29 kPa $ptcO_2$ in the LT group, and 3.20 kPa $ptcO_2$ in the HT group. Lateral wound flap readings demonstrated reductions of 2.39 kPa $ptcO_2$ in the NT group, 3.37 kPa $ptcO_2$ in the LT group, and 6.60 kPa $ptcO_2$ in the HT group during the first 4 days. 14 of 20 NT wound flaps returned to normal within 1 week compared to 10 of 20 LT wound flaps and 3 of 20 HT wound flaps. Hypoxia levels were critical (<3.0 kPa $ptcO_2$) in 15 patients on 2 consecutive days. There was no relation between the period of tourniquet inflation and hypoxia development. 1 HT and 1 NT lateral flap and 1 HT medial flap demonstrated contusion. These flaps were considered critically hypoxic for ≥48 hr after surgery. 1 LT wound that had marked hypoxia was considered superficially infected. The authors conclude that high-pressure thigh tourniquet use after TKR increases postoperative wound hypoxia, that tourniquets should be inflated to the lowest possible pressure to minimize complications, and that using no tourniquet minimized, but did not eliminate, ostoperative hypoxia.
Source: Clarke MT, Longstaff L, Edwards D, et al. Tourniquet-induced wound hypoxia after total knee replacement. *J Bone Joint Surg Br* 2001 Jan;83(1):40-4.

Estebe JP, Le Naoures A, Chemaly L, et al. Tourniquet pain in a volunteer study: effect of changes in cuff width and pressure. *Anaesthesia* 2000 Jan;55:21-6.

Product Identifier:
Pneumatic Tourniquets; Contour Arm Cuffs: (1) 7 cm Proximal Double-Bladder, (2) 14 cm Single-Bladder Low-Pressure; (3) Pneumatic Tourniquets
Manufacturer: (1 and 2) Zimmer Inc [102165], PO Box 708, Warsaw IN 46581-0708; (3) Manufacturer not identified in article
Abstract: The authors compared pneumatic tourniquet pain tolerance using 2 tourniquet cuff widths at 100 mm Hg above systolic blood pressure and at the lowest effective occlusive pressure in 20 volunteers. A wide and a narrow cuff were placed on each arm of the volunteers, who were divided into 2 groups of 10 volunteers each. In the pressure group, the tourniquets were inflated to 100 mm Hg above systolic blood pressure, and in the saturation group, the tourniquets were inflated until the arterial pulsation disappeared at 10 mm Hg. Mean occlusion pressure in the pressure group was 258 ±12 mm Hg and 260 ±8 mm Hg with the narrow and wide cuffs, respectively; mean occlusion pressure in the saturation group was 202 ±4 mm Hg and 147 ±4 mmHg with the 2 cuffs, respectively. The authors state that, in the pressure group, the mean visual analog scale (VAS) scores with the wide cuff were significantly higher and increased faster than the VAS scores with the narrow cuff. In the saturation group, the mean narrow cuff VAS scores increased significantly higher and faster than the wide-cuff scores. Pain was tolerated with the narrow and wide cuffs for 36 ±6 min and 26 ±3 min, respectively, in the pressure group, and for 24 ±9 min and 28 ±5 min, respectively, in the saturation group. The authors conclude that a wide-cuff pneumatic tourniquet is more effective in the occlusion stage than a narrow cuff and that it is less painful when pressure is limited to arterial pulse loss. The authors add that a wide cuff is more painful if pressure is adjusted to 100 mm Hg
above systolic blood pressure.
Source: Estebe JP, Le Naoures A, Chemaly L, et al. Tourniquet pain in a volunteer study: effect of changes in cuff width and pressure. *Anaesthesia* 2000 Jan;55:21-6.

Tsavellas G, Ranaboldo CJ. Tourniquet use during varicose vein surgery: a survey of current practice among Wessex surgeons. *Ann R Coll Surg Engl* 2000 Mar;82(2):116-9.

Product Identifier:
(1) Pneumatic Tourniquets; Tourniquet Cuffs: (2) Rhys-Davies, (3) Roll-On Inflatable
Abstract: The authors assessed the views and current practice of surgeons regarding the use of pneumatic tourniquets during varicose vein surgery. There were 79 respondents to a questionnaire that asked whether the surgeons used a tourniquet during surgery for primary recurrent varicose veins. The frequency of use was graded as regularly, occasionally, and never. 55 of 79 respondents stated that they never used a tourniquet, 10 of 79 respondents stated that they did so occasionally, and 14 of 79 respondents stated that they did so regularly. Among the 24 regular and occasional tourniquet users, 2 reported skin burns attributed to contact with a hot autoclaved rubber wedge as used with a roll-on tourniquet. 22 respondents reported no complications resulting from tourniquet use. The authors conclude that because of tourniquets' safety and benefits, the use of tourniquets during varicose vein surgery should be more widespread.
Source: Tsavellas G, Ranaboldo CJ. Tourniquet use during varicose vein surgery: a survey of current practice among Wessex surgeons. *Ann R Coll Surg Engl* 2000 Mar;82(2):116-9.

Aglietti P, Baldini A, Vena LM, et al. Effect of tourniquet use on activation of coagulation in total knee replacement. *Clin Orthop* 2000 Feb;(371):169-77.

Product Identifier:
(1) Surgical Tourniquets; (2) M.B.K Unilateral Primary Cemented Total Knee
Prostheses
Manufacturer: (1) Manufacturer not identified in article; (2) Zimmer Inc [102165], PO Box 708, Warsaw IN 46581-0708
Abstract: The authors compared the hypercoagulative state occurring during total knee replacement surgery with and without pneumatic tourniquets in 2 groups of 10 patients who received unilateral primary cemented total knee prostheses. Blood samples were collected 1 hr before anesthesia, after bone cuts, 2 minutes after tourniquet deflation in the tourniquet group and after cementing the prosthesis in the nontourniquet group, and 1 hr after surgery. Prothrombin fragments 1 + 2 increased from 1.4 nmol/L to 7.2 nmol/L in the tourniquet group and from 1.6 nmol/L to 9.3 nmol/L in the nontourniquet group. Thrombin and antithrombin complexes increased from a baseline of 10.6 to 18.0 after bone cuts, 41.8 after tourniquet deflation, and 73.0 after surgery in the tourniquet group and from a baseline of 6.2 to 33.0 after bone cuts, 88.0 after cementation, and 117.0 after surgery in the nontourniquet group. The D-dimer value 1 hr after surgery was 1,241 in the tourniquet group compared to 751 in the nontourniquet group. The authors conclude that use of surgical tourniquets canenhance fibrinolysis and prevent deep vein thrombosis in patients undergoing total knee replacement surgery.
Source: Aglietti P, Baldini A, Vena LM, et al. Effect of tourniquet use on activation of coagulation in total knee replacement. *Clin Orthop* 2000 Feb;(371):169-77.

(1) Eyres KS, Sharpe I, Abdel-Salam A; (2) D'Arcy JC, Wakankar HM. The tourniquet in total knee arthroplasty {letter and reply}. *J Bone Joint Surg Br* 1999 Sep;81(5):932.

Product Identifier:
(1) Tourniquets; (2) Insall-Burstein Mark II Cemented Total Knee Prostheses
Manufacturer: (1) Manufacturer not identified in article; (2) Zimmer Ltd [157058], Dunbeath Rd Elgin Industrial Estate, Swindon Wiltshire SN2 6EA, England
See: Abstract below
Update Information: In the above-referenced abstract, the effect of a tourniquet on patients undergoing total knee arthroplasty with a total knee prosthesis is described. The first authors (1) state that it is unclear in the study how many surgeons, and of what grade, operated and where the surgery was performed. The first authors add that the second authors did not discuss what problems were encountered when a tourniquet was not used, and the first authors question the second authors' conclusion that a tourniquet is safe to use, when more wound problems were observed in the patients on whom a tourniquet was used. The first authors recommend

avoiding the use of tourniquets because of possible complications, such as nerve paralysis, vascular injury, circulatory changes on exsanguination with cardiac or respiratory problems, cardiac arrest, pulmonary edema, increased rates of deep vein thrombosis, and increased rates of embolism. The first authors conclude that total knee prosthesis implantation can now be performed without the use of a tourniquet and that many of the local and systemic complications of operating in a bloodless field can be avoided.
The second authors (2), the authors of the referenced article, respond that surgery can be safely performed without a tourniquet, especially in the presence of risk factors; however, in the absence of risk factors, they state that it is safe to use a tourniquet.
Source: (1) Eyres KS, Sharpe I, Abdel-Salam A; (2) D'Arcy JC, Wakankar HM. The tourniquet in total knee arthroplasty {letter and reply}. *J Bone Joint Surg Br* 1999 Sep;81(5):932.

(1) Agu O, Baher D, Hamilton G; (2) D'Arcy JC, Wakankar HM. The tourniquet in total knee arthroplasty {letter and reply}. *J Bone Joint Surg Br* 1999 Sep;81(5):932-3.

Product Identifier:
(1) Tourniquets; (2) Insall-Burstein Mark II Cemented Total Knee Prostheses
Manufacturer: (1) Manufacturer not identified in article; (2) Zimmer Ltd [157058], Dunbeath Rd Elgin Industrial Estate, Swindon Wiltshire SN2 6EA, England
See: Abstract below
Update Information: In the above-referenced abstract, the effect of a tourniquet on patients undergoing total knee arthroplasty with a total knee prosthesis is described. The first authors (1) state that duplex ultrasonography is unreliable for diagnosing calf vein thrombosis and that the use of duplex ultrasonography in the referenced study may be partially responsible for the low incidence of deep vein thrombosis reported. The first authors recommend that a more reliable diagnostic tool, such as contrast phlebography, be used to diagnose calf vein thrombosis. The first authors add that the only case of deep vein thrombosis reported was in the tourniquet group and that the difference was reported as insignificant. The first authors conclude that it may be dangerous to ignore the risk of venous thrombosis and potential fatal embolism associated with the continued use of a tourniquet in total knee prosthesis implantation.
The second authors (2), the authors of the above-referenced abstract, respond that their small study did not demonstrate any serious consequences with the use of a tourniquet in total knee prosthesis implantation. The second authors conclude that contrast venography is the optimum method of diagnosis of deep vein thrombosis. The authors add that they did not ignore the risk of deep vein thrombosis and pulmonary embolism, but their study did not confirm findings of higher incidence reported in an earlier study.

Source: (1) Agu O, Baher D, Hamilton G; (2) D'Arcy JC, Wakankar HM. The tourniquet in total knee arthroplasty {letter and reply}. *J Bone Joint Surg Br* 1999 Sep;81(5):932-3.

(1) Ömeroğlu H, Seber S; (2) D'Arcy JC, Wakankar HM. The tourniquet in total knee arthroplasty {letter and reply}. *J Bone Joint Surg Br* 1999 Sep;81(5):934.

Product Identifier:
(1) Tourniquets; (2) Insall-Burstein Mark II Cemented Total Knee Prostheses
Manufacturer: (1) Manufacturer not identified in article; (2) Zimmer Ltd [157058], Dunbeath Rd Elgin Industrial Estate, Swindon Wiltshire SN2 6EA, England
See: Abstract below
Update Information: In the above-referenced abstract, the effect of a tourniquet on patients undergoing total knee arthroplasty with a total knee prosthesis is described. The first authors (1) state that they disagree with the finding of the similarity of the intensity of early postoperative pain between those patients with the tourniquet applied and those without the tourniquet. The first authors conclude that ischemia induced by the use of a tourniquet for longer than 1 hr leads to ultrastructural damage to the skeletal muscle distal to the cuff. The second authors (2), the authors of the above-referenced abstract, respond that pain is difficult to quantify. The second authors conclude that the final outcome demonstrated no difference in knee flexion in patients who did and did not have a tourniquet, which suggests that there was full muscle recovery from any temporary damage.
Source: (1) ömeroğlu H, Seber S; (2) D'Arcy JC, Wakankar HM. The tourniquet in total knee arthroplasty {letter and reply}. *J Bone Joint Surg Br* 1999 Sep;81(5):934.

Coleman MM, Peng PW, Regan JM, et al. Quantitative comparison of leakage under the tourniquet in forearm versus conventional intravenous regional anesthesia. *Anesth Analg* 1999 Dec; 89(6):1482-6.

Product Identifier:
(1) 14 cm Double Tourniquets; (2) 22 G Cannulae
Manufacturer: (1) Zimmer Inc [102165], PO Box 708, Warsaw IN 46581-0708; (2) Manufacturer not identified in article
Abstract: The authors quantitatively compared leakage under a double tourniquet during intravenous regional anesthesia (IVRA) in the forearm and upper arm in 14 patients. Leakage in the upper arm and forearm was 10% ±20% and 6% ±12%, respectively. A mean forearm leakage of 59% ±11% and a mean upper-arm leakage of 70% ±7% were recorded 3 min after deflation. A forearm leakage of 69% ±11% and an upper-arm leakage of 82% ±5% were observed 20 min after deflation. The authors conclude that leakage under the double tourniquet is similar in both forearm and upper-arm IVRA and that, with lower dose requirements, forearm IVRA will increase
the safety margin of the IVRA technique.
Source: Coleman MM, Peng PW, Regan JM, et al. Quantitative comparison of leakage under the tourniquet in forearm versus conventional intravenous regional anesthesia. *Anesth Analg* 1999 Dec; 89(6):1482-6.

Hooper J, Rosaeg OP, Krepski B, et al. Tourniquet inflation during arthroscopic knee ligament surgery does not increase postoperative pain. *Can J Surg* 1999 Oct;46(10):925-9.

Product Identifier:
ATS 1500 Pneumatic Tourniquet Systems
Manufacturer: Zimmer Inc [102165], PO Box 708, Warsaw IN 46581-0708
Abstract: The authors compared the effect of a pneumatic tourniquet inflated to 300 mm Hg on the thigh in 14 patients and not inflated in 15 patients undergoing anterior cruciate ligament (ACL) surgery. Pain management, surgery duration, and arthroscopic visibility were assessed. The authors state that there was no difference between the groups in surgery duration, postoperative morphine requirements, or pain scores and that both groups rated postoperative pain management as excellent or very good. The authors add that arthroscopic visibility was significantly impaired in the inflation group. The authors conclude that inflation of a thigh tourniquet does not increase pain or opiate (i.e., morphine) consumption after arthroscopic ACL surgery and that impaired arthroscopic visibility can be corrected by increased irrigation flow or the addition of epinephrine. They add that surgical time was not increased in patients without tourniquet inflation.
Source: Hooper J, Rosaeg OP, Krepski B, et al. Tourniquet inflation during arthroscopic knee ligament surgery does not increase postoperative pain. *Can J Surg* 1999 Oct;46(10):925-9.

Mohler LR, Pedowitz RA, Lopez MA, et al. Effects of tourniquet compression on neuromuscular function. *Clin Orthop* 1999 Feb;359:213-20.

Product Identifier:
Inflatable Thigh Tourniquets
Abstract: The authors examined 84 rabbits that underwent thigh tourniquet compressions of 0 mm Hg, 125 mm Hg, and 350 mm Hg to determine how increased pressure influences contractile function beneath and distal to the tourniquet. The authors state that 2 days after tourniquet removal, the quadriceps and the tibialis anterior muscles of rabbits in the tourniquet group experienced significant loss of contractile forces compared to those of the control group. After 3 weeks, quadriceps force returned to 94% of the maximal control force after 125 mm Hg compression but only to 83% of the maximal control force after 350 mm Hg compression. Tibialis anterior force production was 88% of the mean control force after 125 mm Hg compression and 83% of the mean control force after 350 mm Hg compression. The authors conclude that mechanical injury from tourniquet compression plays a major role in neuromuscular dysfunction, and the magnitude of the compression significantly affects the degree of isometric contractile dysfunction in the quadriceps and tibialis anterior muscles after tourniquet use.
Source: Mohler LR, Pedowitz RA, Lopez MA, et al. Effects of tourniquet
compression on neuromuscular function. *Clin Orthop* 1999 Feb;359:213-20.

Marson BM, Tokish JT. The effect of a tourniquet on intraoperative patellofemoral tracking during total knee arthroplasty. *J Arthroplasty* 1999 Feb;14(2):197-9.

Product Identifier:
(1) Tourniquets; (2) Insall-Burstein II Posterior Stabilized Total Knee Prostheses
Manufacturer: (1) Manufacturer not identified in article; (2) Zimmer Inc [102165], PO Box 708, Warsaw IN 46581-0708
Abstract: The authors investigated whether an inflated tourniquet affected intraoperative patellofemoral tracking during 75 total knee arthroplasties using a posterior stabilized total knee prosthesis. They state that 34 knees tracked properly with or without the tourniquet inflated, 36 knees maltracked with the tourniquet inflated but tracked properly with the tourniquet deflated, and 5 knees maltracked with and without the tourniquet inflated. The authors also state that a lateral release procedure was avoided in patients whose knees tracked incorrectly with tourniquet inflation but tracked correctly without tourniquet inflation. The authors conclude that
use of a tourniquet can alter intraoperative patellofemoral tracking and that the tourniquet should be deflated to more accurately assess tracking before proceeding with lateral release procedures.
Source: Marson BM, Tokish JT. The effect of a tourniquet on intraoperative patellofemoral tracking during total knee arthroplasty. *J Arthroplasty* 1999 Feb;14(2):197-9.

Wakankar HM, Nicholl JE, Koka R, et al. The tourniquet in total knee arthroplasty. A prospective, randomised study. *J Bone Joint Surg Br* 1999 Jan;81(1):30-3.

Product Identifier:
(1) Tourniquets; (2) Insall-Burstein Mark II Cemented Total Knee Prostheses
Manufacturer: (1) Manufacturer not identified in article; (2) Zimmer Ltd [157058], Dunbeath Rd Elgin Industrial Estate, Swindon Wiltshire SN2 6EA, England
Abstract: The authors describe the effect of a tourniquet in a group of 77 patients undergoing total knee arthroplasty (TKA) with a total knee prosthesis. 37 patients underwent TKA with a tourniquet, while 40 patients underwent TKA without a tourniquet. Bleeding was considered a nuisance in 7 of 40 patients in whom a tourniquet was not used; moderate bleeding was observed in another 6 patients without the tourniquet. 3 of 37 knees in which tourniquets were used exhibited blisters, 1 knee had severe bruising, and 3 knees had oozing wounds, compared to 1 case of blistering, 1 case of severe bruising, and 3 cases of oozing in patients operated on without the tourniquet. The authors state that the tourniquet was not associated with an increased incidence of wound complication or deep vein thrombosis. They state that patients without the tourniquet had better flexion at 1 week postoperatively and that there was no difference at 6 weeks postoperatively. The authors conclude that tourniquet use is safe and effective in patients undergoing TKA with a total knee prosthesis.
Source: Wakankar HM, Nicholl JE, Koka R, et al. The tourniquet in total knee arthroplasty. A prospective, randomised study. *J Bone Joint Surg Br* 1999 Jan;81(1):30-3.

Ogino Y, Tatsuoka Y, Matsuoka R, et al. Cerebral infarction after deflation of a pneumatic tourniquet during total knee replacement. *Anesthesiology* 1999 Jan;90(1):297-8.

Product Identifier:
Pneumatic Tourniquets
Abstract: The authors describe a case in which a patient became unresponsive 20 min after a pneumatic tourniquet was removed following total knee replacement. The patient had left face palsy, left upper-limb paresis, and global aphasia with unconsciousness. The patient recovered 3 days later. A left-to-right shunt through a small atrial septal defect was observed using echocardiography. The authors hypothesize that after tourniquet deflation, thromboemboli distal to the tourniquet passed through the defect. Magnetic resonance imaging of the patient's brain demonstrated cerebral infarction caused by cerebral embolism that immediately followed the release of the tourniquet. The authors conclude that the potential risk of paradoxical embolism should be considered in the management of orthopedic procedures during tourniquet control.
Source: Ogino Y, Tatsuoka Y, Matsuoka R, et al. Cerebral infarction after deflation of a pneumatic tourniquet during total knee replacement. *Anesthesiology* 1999 Jan;90(1):297-8.

(1) Henderson MS, Newman JH, Hand CG; (2) Barwell J, Anderson G, Hassan A, et al. Early tourniquet release during total knee arthroplasty {letter}. *J Bone Joint Surg Br* 1998 Mar;80(2):372.

Product Identifier:
Surgical Tourniquets
See: Abstract below
Update Information: In the above-referenced abstract, it is suggested that early tourniquet release following total knee arthroplasty reduces tissue tension, achieves hemostasis before wound closure, and enables anesthetists to estimate total blood loss before the patient leaves the operating area. The first authors (1) state that if the tourniquet is not released until after wound closure, the entire amount of blood lost during the procedure is potentially salvageable. They conclude that the advantages of early tourniquet release are outweighed by the potential to reduce the need for allogenic blood transfusion and its associated risks. The second authors (2) reply that blood loss is unaffected by the timing of tourniquet release and state that early tourniquet release does not preclude the use of autologous blood transfusion.
Source: (1) Henderson MS, Newman JH, Hand CG; (2) Barwell J, Anderson G, Hassan A, et al. Early tourniquet release during total knee arthroplasty {letter}. *J Bone Joint Surg Br* 1998 Mar;80(2):372.

Kokki H, Väätäinen U, Penttilä I. Metabolic effects of a low-pressure tourniquet system compared with a high-pressure tourniquet system in arthroscopic anterior crucial ligament reconstruction. *Acta Anaesthesiol Scand* 1998 Apr;42(4):418-24.

Product Identifier:
Pneumatic Tourniquets: (1) ATS 1500 Microprocessor-Controlled, (2) Inflomatic 3000 Low-Pressure Regulator; Tourniquet Cuffs: (3) ATS Low-Pressure 14 cm Wide Curved Dual Port with Shell, (4) 7 cm Wide Straight Single Port
Manufacturer: (1 through 4) Zimmer Inc Patient Care Div [106577], PO Box 10, Dover OH 44622-0010
Abstract: The authors studied the metabolic effects of use of a low-pressure tourniquet system compared with use of a high-pressure tourniquet system during arthroscopic anterior cruciate ligament reconstruction in 26 patients. In the low-pressure group, a 14 cm wide, curved, dual-port cuff with shell was connected to a microprocessor; in the high-pressure group, a 7 cm wide, straight, single-port cuff was connected to a low-pressure tourniquet regulator. Tourniquet times varied between 30 and 144 min. Deflation of the tourniquet caused a significant release of lactate, myoglobin, and potassium, detected in the femoral vein blood in both the low-pressure and high-pressure groups. pCO_2 increased, but pH and pO_2 decreased after tourniquet deflation in both groups. The authors state that the tourniquet time showed a significant correlation with the femoral vein lactate. The authors conclude that the metabolic changes were more pronounced with longer tourniquet time. They add that there was no difference between the 2 tourniquet systems with respect to metabolic markers of muscular injury during the first hour after release of the tourniquet.
Source: Kokki H, Väätäinen U, Penttilä I. Metabolic effects of a low-pressure tourniquet system compared with a high-pressure tourniquet system in arthroscopic anterior crucial ligament reconstruction. *Acta Anaesthesiol Scand* 1998 Apr;42(4):418-24.

Whitford A, Healy M, Joshi GP, et al. The effect of tourniquet release time on the analgesic efficacy of intraarticular morphine after arthroscopic knee surgery. *Anesth Analg* 1997 Apr;84(4):791-3.

Product Identifier:
Tourniquets
Abstract: The authors evaluated the effects of tourniquet release time on the analgesic efficacy of intra-articular (IA) morphine in 40 patients undergoing arthroscopic knee surgery. They state that tourniquet inflation pressures were between 300 and 350 mm Hg and that inflation was maintained for 10 min after IA injection in 1 group of 20 patients and was immediately released in a second group of 20 patients. Pain scores were significantly lower in patients with 10 min maintenance of tourniquet inflation, and analgesia requests occurred at 8 hr in these patients compared to 2 hr in patients with immediate tourniquet release. 6 patients who had 10 min maintenance of tourniquet inflation required 1 supplemental dose of analgesia, compared to 17 patients with immediate tourniquet release who required additional analgesia 1 or more times. The authors conclude that maintaining tourniquet inflation for 10 min after IA morphine injection improves pain control and reduces the need for supplemental analgesia in arthroscopic knee surgery patients.
Source: Whitford A, Healy M, Joshi GP, et al. The effect of tourniquet release time on the analgesic efficacy of intraarticular morphine after arthroscopic knee surgery. *Anesth Analg* 1997 Apr;84(4):791-3.

Townsend HS, Goodman SB, Schurman DJ, et al. Tourniquet release: systemic and metabolic effects. *Acta Anaesthesiol Scand* 1996 Nov;40(10):1234-7.

Product Identifier:
Pneumatic Tourniquets
Abstract: The authors discuss the effects of pneumatic tourniquet release on arterial blood pressure and metabolic status in patients receiving general anesthesia with mechanical ventilation. 11 patients undergoing total knee replacement participated in a study including continuous mean arterial pressure (MAP) and arterial blood analysis with pH and electrolyte measurements and bicarbonate calculations. 3 min after tourniquet release, MAP decreased and remained lower up to 15 min. Changes in blood gas and electrolyte values returned to near baseline values after 30 min to 1 hr. The authors noted that the pH changes were influenced more by the controlled ventilation rate in general anesthesia than by ischemia. The authors conclude that MAP falls significantly after tourniquet release and that more time is required for normalization of metabolic abnormalities in general anesthesia than in epidural anesthesia.
Source: Townsend HS, Goodman SB, Schurman DJ, et al. Tourniquet release: systemic and metabolic effects. *Acta Anaesthesiol Scand* 1996 Nov;40(10):1234-7.

Barwell NJ, Anderson G, Hassan A, et al. The effects of early tourniquet release during total knee arthroplasty. *J Bone Joint Surg Br* 1997 Mar;79(2):265-8.

Product Identifier:
Surgical Tourniquets
Abstract: The authors evaluated tourniquet release after wound closure and compression bandaging in total knee arthroplasty. They note that in 44 patients undergoing skin closure and bandage application before tourniquet release, 13 patients experienced minor wound complications, 9 patients experienced excessive swelling, and 5 patients required further surgery. In 44 patients undergoing tourniquet release before closure, 6 patients experienced minor wound complications, and 2 patients experienced excessive swelling, but none of the patients returned to the operating room. The authors conclude that releasing the tourniquet reduces tissue tension and achieves hemostasis before closure and that early tourniquet release enables anesthetists to estimate total blood loss before the patient leaves the operating area.
Source: Barwell NJ, Anderson G, Hassan A, et al. The effects of early tourniquet release during total knee arthroplasty. *J Bone Joint Surg Br* 1997 Mar;79(2):265-8.

Finsen V, Kasseth AM. Tourniquets in forefoot surgery. Less pain when placed at the ankle. *J Bone Joint Surg* (Br) 1997 Jan;79(1):99-101.

Product Identifier:
Pneumatic Tourniquets
Abstract: The authors studied the effect of pneumatic tourniquet placement on pain and neurological complications in 49 patients undergoing forefoot surgery. Cuffs were placed either at calf level (n = 24) or just above the ankle (n = 25), and mean pressures were almost identical. Operating surgeons reported a bloodless surgical field with both positions. Patients with ankle placement reported significantly less pain during the operation than those with calf placement; the authors hypothesize that this is because less unanesthetized tissue becomes ischemic during tourniquet compression. The authors conclude that an ankle tourniquet is less painful with no increase in neurological complications.
Source: Finsen V, Kasseth AM. Tourniquets in forefoot surgery. Less pain when placed at the ankle. *J Bone Joint Surg* (Br) 1997 Jan;79(1):99-101.

Estebe JP, LeNaoures A, Malledant Y, et al. Use of a pneumatic tourniquet induces changes in central temperature. *Br J Anaesth* 1996 Dec;77(6):786-8.

Product Identifier:
Pneumatic Tourniquets
Abstract: The authors studied the effect of prolonged limb tourniquet use on esophageal and rectal temperatures in 26 male adult patients undergoing orthopedic surgery. Tourniquets were used in 20 patients: 10 had the available skin surface covered with passive reflective insulation material and 10 were covered with a forced air warming system. 6 patients with contraindications or no indications for the use of the tourniquet were treated without the device. An increase in temperatures was seen in both tourniquet groups but not in the group without tourniquets, and temperatures continued to increase as long as the device was inflated. Rectal temperature changes were similar but significantly delayed when compared to esophageal temperature changes. Temperatures decreased rapidly following release of the tourniquet. An increase in arterial pressure during tourniquet use was also seen, as was an increase in end-tidal CO_2 at deflation. The authors postulate that the release of ischemic metabolites from the extremity into the bloodstream, possibly through bone, causes the increase in body temperature.
Source: Estebe JP, LeNaoures A, Malledant Y, et al. Use of a pneumatic tourniquet induces changes in central temperature. *Br J Anaesth* 1996 Dec;77(6):786-8.