

# Total Knee Arthroplasty Without the Use of a Tourniquet

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The major benefit of TKA with tourniquet is operating in a bloodless field. A possible secondary benefit is a better cement bone interface for fixation. The disadvantages of tourniquet use for TKA include multiple risk factors both local and systemic including: nerve damage, altered hemodynamics with limb exsanguinations and reactive hyperemia with tourniquet release, delay in recovery of muscle or nerve function, increased risk of DVT with direct trauma to vessel walls and increased levels of thrombin-antithrombin complexes. A greater risk for large venous emboli propagation and trans-esophageal echogenic particles, vascular injury with higher risk in atherosclerotic, calcified arteries, and an increase in wound healing disturbances. Our initial experience with TKA without tourniquet was in high risk patients with previous DVT or PE, multiple scarring, or compromised cardiovascular status. We have used this method on all patients for the last eight years. The protocol includes regional anesthesia, incision and approach made with 90 degree knee flexion, meticulous hemostasis, jet lavage and filtered carbon dioxide delivered to dry and prepare bone beds for cementation and routine closure. We have encountered no differences in blood loss or transfusion rates, less post-op pain, faster straight leg raise and knee flexion gains, and fewer wound healing disturbances. We recommend TKA without tourniquet.

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Total knee arthroplasty (TKA) is usually performed with a tourniquet. A recent survey of members of the American Association of Hip and Knee surgeons<sup>1</sup> reported that 95% used a tourniquet for TKA. In stark contrast, only 5% did not use a tourniquet, but those surgeons did elevate the tourniquet for cementation purposes only. Therefore, the tourniquet is widely perceived to provide the benefit of operating in a bloodless field. However, the other theoretic advantage of providing a better interface for implant, cement, bone bonding has never been proven.<sup>2,3</sup>

## Problems with the Use of Tourniquets

The potential benefits of TKA with a tourniquet must be balanced by a realistic assessment of the inherent risks. These

risks can be neuromuscular, vascular, or cutaneous, with blisters forming under the tourniquet or wound healing disturbances.<sup>2</sup>

The most common complication is nerve paralysis. This can be caused by direct pressure or by ischemic hypoxia with tourniquet use.<sup>4-6</sup> Neurologic dysfunction increases with total tourniquet time. Even tourniquet release for a reperfusion interval only minimally decreases the likelihood of nerve damage.<sup>7</sup> There can also be a significant delay in the recovery of muscle function after tourniquet use.<sup>2</sup> The direct pressure of the tourniquet can be a source of postoperative pain and cause slower gains of knee flexion.<sup>8</sup>

Cardiovascular hemodynamics are altered with exsanguination of the limb during tourniquet application. There is a 15%-20% increase in circulatory volume, which may tax the cardiovascular system in already-compromised patients.<sup>9</sup> In addition, after the tourniquet is released, there is a 10% increase in limb size because of reactive hyperemia.<sup>10</sup> This may increase soft tissue tension, which may compromise wound healing.

The application of a tourniquet will impair venous drainage of the limb and damage the venous and arterial endothe-

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lium.<sup>11</sup> Parmet and colleagues<sup>12</sup> demonstrated that tourniquet use during TKA placed patients at a 5.3-fold greater risk of developing large venous emboli than those patients in whom tourniquet was not used for TKA.

Several investigators have shown an increase in transesophageal echogenic particles after the tourniquet was released. In a Japanese study, all patients sustained embolic phenomena after release.<sup>13</sup> If the embolic shower was significant, cardiopulmonary impairment occurred.

The use of a tourniquet should be discouraged in patients with preexisting limb vascular disease. Certainly, the finding of a calcified femoral arterial tree would preclude the use of a tourniquet. In addition, any patient with previous peripheral arterial surgery would have potential complications if a tourniquet is inflated.

Our early experience in Dallas of TKA without tourniquet was developed in high-risk patients with previous deep venous thrombosis or pulmonary embolus, multiple scarring, vascular calcification or previous limb vascular surgery, or cardiopulmonary compromise. For the last 8 years, we have not used a tourniquet in primary or revision TKA.

## Dallas Operative Protocol for TKA Without a Tourniquet

Regional anesthesia is encouraged and has been associated with a reduction in intraoperative blood loss, the need for transfusion, and the incidence of deep-vein thrombosis when compared with general anesthesia.<sup>14,15</sup>

The surgical incision and approach are performed with the knee flexed 90 degrees. A meticulous hemostasis is done because all vessels are readily identified and coagulated. After the femur and tibia bone cuts are accomplished, the knee is adjusted for flexion-tension balancing. This exposes the posterior capsular structures and a local field block is performed with 0.25% ropivacaine and epinephrine. Most persistent bleeders are in the midline of the posterior structures and surface coagulation is performed under direct vision.

After the knee has been fully prepared and balanced, pulsatile jet lavage is applied to the bone surfaces. Next, filtered carbon dioxide under pressure (Carbojet; Kinamed, Inc, Camarillo, CA) is delivered to the bone to dry and further cleanse the bone beds for cementation (Fig. 1). A high-viscosity cement is then used in routine fashion to complete implant fixation. Tranexamic acid (3 g per 100 mL of normal saline) is applied topically. The wound is then closed in layers. No drains are used and a compressive dressing is applied. Early mobilization rehabilitation is initiated.<sup>16</sup>

Our observations of TKA without tourniquet correspond closely to those in the published literature.<sup>2</sup> We have found no differences in blood loss or transfusion rates. We have witnessed less postoperative pain medications used, faster straight leg raising, and faster knee flexion gains, but there is no statistical significance. We have also encountered fewer wound healing disturbances, especially in immune-compromised patients. Cement bone penetrations or postoperative radiographs have been equivalent.



**Figure 1** Carbojet-filtered carbon dioxide delivery system.

The Dallas experience and that of other authors has shown that orthopedic surgeons can have increasing confidence that TKA can be performed without a tourniquet. Certainly a tourniquet should not be used in patients with peripheral vascular disease, rheumatoid arthritis, immune suppression and previous deep venous thrombosis or pulmonary embolus. We recommend TKA without tourniquet for all patients to avoid the many local and systemic complications that can occur when operating in a bloodless field.

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