Isolated Lateral Locked Plating versus Cable Plating and Strut Allograft for Vancouver B1 Periprosthetic Femur Fractures: A Randomized Controlled Trial

Surgical Technique Guide

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Background and Rationale

Periprosthetic proximal femur fractures after total hip arthroplasty are challenging. The surgery can be difficult in an elderly, frail patient and a rapid return to function is desirable. Fracture fixation is often compromised by poor bone stock and limited by the femoral prosthesis. Failed fixation, mal-alignment and prolonged immobilization must be avoided to optimize outcomes and allow the patient a quicker return to function. A fracture fixation construct that provides adequate stability, restores alignment, and addresses compromised bone stock is ideal and would be expected to be associated with a quicker return to function, reduced re-operations, and reduced complications such as nonunion, malunion, infection and implant failure.

The optimal fixation construct to achieve these goals in periprosthetic fractures about a stable femoral component (Vancouver B1) is controversial with some authors advocating for isolated locking plate fixation (which allows for limited soft tissue dissection combined with locking fixation) and others advocating for cable plating combined with allograft strut fixation (which confers greater stability and restores bone stock). High level evidence comparing the two strategies is completely lacking. The purpose of this study is to compare these two treatment methods for the fixation of Vancouver B1 periprosthetic femur fractures in a prospective randomized trial. We aim to compare isolated locking plate fixation using indirect reduction techniques to cable plating with strut allograft to determine which treatment, if any, results in a quicker return to function and reduced complications.

This is a multi-centre, randomized controlled trial involving institutions affiliated with the Canadian Orthopaedic Trauma Society (COTS), the Canadian Arthroplasty Society (CAS) as well as International sites.

Hypothesis

Our hypothesis is that patients treated with cable plating with allograft strut will have a quicker return to function as measured by the Timed Up and Go (TUG) test when compared to the isolated locked plating group.

Study Outcomes

The primary outcome measure will be the (TUG) test at 6 weeks. The TUG is a very simple timed test designed to measure mobility in the elderly. It involves documenting the time, in seconds, taken for subjects to rise from a standard arm chair, walk to a line on the floor 3 meters away, turn, return, and sit down again. This test has been strongly correlated with return of function in elderly patients with fractures of the proximal femur. Secondary outcomes will include rates of nonunion and malunion, rates of mortality, rates of re-operation, rates of implant failure, rates of infection and total complication rate.
Inclusion Criteria

- Age: over 18, no upper limit
- Vancouver type B1 periprosthetic fracture
- Fracture is amenable to either treatment group
- Prosthesis is well fixed
- Provision of written informed consent

Exclusion Criteria

- Presence of an active infection around the fracture (soft tissue or bone)
- Trauma patients with an ISS > 15 or associated major injuries of the lower extremities
- Known substance abuse
- Likely problems, in the judgment of the investigators, with maintaining follow-up (i.e., patients with no fixed address, report a plan to move out of town, or intellectually challenged patients without adequate family support).

Sample Size

Sample size calculations are based on comparing the TUG times at the 6 week time point by means of the independent two-sample t-test. A standard deviation of 13 is assumed for TUG. The trial is designed to have 80% power to detect an 8 second difference in TUG, using a Type I error probability of 5% (two-tailed). The minimum required sample size, given the preceding requirements and assumptions is 43 patients per group. We have accounted for a 20% loss to follow-up (N=43 x 1/1-.2 = 53.7) resulting in a total sample size of 54 patients in each group or 108 patients total.
The goal of this surgical technique guide is to help standardize the surgical interventions in the two surgical groups for the randomized trial “Isolated Lateral Locked Plating versus Cable Plating and Strut Allograft for Vancouver B1 Periprosthetic Femur Fractures”.

We recognize that individual fracture patterns, patient characteristics, and surgeon experience/preference may dictate some variation from the techniques described here.

It is critical that loosening of the femoral component (Vancouver B2) is ruled out (as best as possible) prior to enrolling the patient in this study.

In the event that loosening of the femoral component is encountered intra-operatively, patients can/should be treated with revision arthroplasty and fracture fixation. We have accounted for this potential loss of patients in our sample size calculation.

Group A: Isolated Lateral Locked Plating

1. Details of the construct are shown in Figure 1 and Figure 2.
2. The patient is positioned supine on a radiolucent table (patient positioning can be lateral decubitus at surgeon discretion).
3. The limb is prepped and draped to allow full access to the limb and the total hip arthroplasty (THA) incision.
4. A portion of the THA incision is used combined with percutaneous distal incisions (see Figure 3). Care should be taken to avoid soft tissue stripping and devascularization at the fracture site.
5. An appropriate length of lateral locking plate is selected (see Figure 4). It is recommended that the plate span the majority of the femur – from the greater trochanter down to the supracondylar region. The choice of locking plate type/brand is at the discretion of the surgeon.
6. The plate is applied in a submuscular fashion to the lateral aspect of the femur, after contouring as required.
7. Reduction is achieved by indirect methods and confirmed with intra-operative fluoroscopy (see Figure 5).
8. Proximal fixation is achieved with a combination of both cables/wires and locking screws/non-locking screws. Proximal fixation must employ at least two cables/wires and at least one locking screw.
9. Distal fixation is achieved with a combination of locking and non-locking screws. At least one distal locking screw should be used. The use of ‘spaced fixation’ (50% screw fill) distally is encouraged.
10. General fracture principles are encouraged (i.e. compression/lagging of simple fracture patterns and bridge plating of comminuted fractures).

Figure 1: Illustration of the construct for Group A: Isolated lateral locked plating of Vancouver B1 periprosthetic fracture.
Figure 2: Radiographs of a 78 year old female patient with a Vancouver Type B1 periprosthetic fracture at the tip of a well-fixed stem that had been functioning well prior to a fall (A, B, C). Post-operative radiographs showing fixation of the fracture with isolated lateral locked plating using a minimally invasive approach (D, E, F).
Figure 3: Intra-operative photographs demonstrating patient positioning and preparation.
Figure 4: Intra-operative photographs demonstrating plate selection and submuscular tunneling of the plate along the lateral aspect of the femur.
Figure 5: Intra-operative and sequential fluoroscopic images demonstrating provisional plate placement and reduction followed by definitive fixation.
Group B: Cable Plating and Strut Allograft (90-90 Fixation)

1. Details of the construct are shown in Figure 6 and Figure 7.
2. The patient is positioned supine on a radiolucent table (patient positioning can be lateral decubitus at surgeon discretion).
3. The limb is prepped and draped to allow full access to the limb and total hip arthroplasty (THA) incision.
4. A portion of the THA incision is used combined with extension distally to the level of the supracondylar region (see Figure 8). A lateral approach is used to expose the length of the femur. Care should be taken to avoid soft tissue stripping and devascularization along the medial and posterior aspects of the femur.
5. An appropriate length of lateral plate is selected. It is recommended that the plate span the majority of the femur – from the greater trochanter down to the supracondylar region. The choice of plate (locking vs. non-locking) is at the discretion of the surgeon.
6. The plate is applied to the lateral aspect of the femur, after contouring as required (see Figure 9).
7. Reduction is achieved directly and confirmed with intra-operative fluoroscopy. Provisional screw fixation is placed proximally and distally and reduction is confirmed.
8. Cables/wires are passed around the femur and lateral plate (minimum of 2 cables proximal and distal to the fracture). Care should be taken to stay directly on bone with the cables/wires to avoid the entrapment of neurovascular structures.
9. An anterior allograft strut 20-30 cm in length is fashioned to fit the anterior aspect of the femur (see Figures 10 and 11). The strut can be from the femur, tibia or humerus (fibular struts are not allowed).
10. The strut is placed anterior to the femur and the previously passed cables/wires are secured around the femur, plate, and allograft. The cables/wires are tightened and then trimmed (see Figure 12).
11. Further/definitive screw fixation is then placed.
12. Proximal fixation is achieved with a combination of both cables/wires and locking screws/non-locking screws. Proximal fixation must employ at least two cables/wires around the plate and allograft and at least one screw.
13. Distal fixation is achieved with a combination of both cables/wires and locking screws/non-locking screws. Distal fixation must employ at least two cables/wires around the plate and allograft, and at least one screw. The use of ‘spaced fixation’ (50% screw fill) distally is encouraged.
14. General fracture principles are encouraged (i.e. compression/lagging of simple fracture patterns and bridge plating of comminuted fractures).
Figure 6: Illustration of the construct for Group B: Cable plating and strut allograft (90-90 fixation) of a Vancouver B1 periprosthetic fracture.
Figure 7: Radiographs of an 82 year old female patient with a Vancouver Type B1 periprosthetic fracture at the tip of a well-fixed bipolar stem that had been functioning well prior to a fall (A and B). Post-operative radiographs showing fixation of the fracture with a lateral plate and strut allograft (C, D, E, F).
Figure 8: Intra-operative photographs demonstrating patient positioning and surgical approach for cable plating and strut allograft fixation.
Figure 9: Intra-operative photographs demonstrating direct reduction and provisional lateral plate fixation.
Figure 10: Intra-operative photograph demonstrating strut allograft preparation.
**Figure 11:** Intra-operative photographs demonstrating strut allograft and anterior placement.

**Figure 12:** Intra-operative photograph demonstrating the final construct of a lateral cable plate and anterior strut allograft (90-90 fixation).
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