The Knee 21 (2014) 172–175

Contents lists available at ScienceDirect

The Knee

Opening wedge distal femoral varus osteotomy for lateral compartment osteoarthritis in the valgus knee

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ARTICLE INFO

Article history:
Received 19 December 2012
Received in revised form 15 July 2013
Accepted 20 August 2013

Keywords:
Distal femoral
Valgus
Lateral
Osteoarthritis
Varus osteotomy

ABSTRACT

Introduction: Osteotomy aims to reduce pain and the rate of progression of arthritis by correcting deformity and offloading the affected compartment. This study reports the results of a case series of opening wedge distal femoral varus osteotomies for valgus lateral osteoarthritis of the knee.
Patients and methods: Eighteen patients underwent osteotomy surgery (21 knees) with the aim of correcting the mechanical axis to 48–50% from medial to lateral.
Results: The mean follow-up for the study population was 4.5 years (range 1.6 to 9.2 years). Four patients underwent conversion to arthroplasty at a mean time of 3.3 years postosteotomy. Kaplan–Meier analysis demonstrates a cumulative survival of 79% at 5 years. In the remaining 17 osteotomies, all patients reported that outcome measures improved from baseline. However, only the IKDC and pain subdomain of KOOS showed a statistically significant and clinically relevant difference. Re-operation for non-arthroplasty related surgery was common. In part this was due to symptoms related to prominence of metalwork (10). Other reasons included non-union (1), loss of correction (2), infection (1), and persistent symptoms (2).
Conclusion: Cumulative survival of opening wedge DFVO is comparable with that reported in closing wedge series. Clinically relevant differences in the IKDC and KOOS pain scores suggest that opening wedge DFVO is a useful option in the management of valgus gonarthrosis. However, DFVO is a technically demanding procedure and re-operation, particularly for removal of metalwork, is common.

1. Introduction

Lateral compartment gonarthrosis in a young patient represents a challenge for the orthopaedic surgeon. Although arthroplasty reliably offers symptomatic relief and long-term implant survivorship in elderly patients, there is a logical reluctance to avoid joint replacement in younger, more active individuals who have a 3–5 fold increased risk of revision surgery [1].

A joint preserving alternative to arthroplasty is realignment osteotomy. This procedure aims to reduce pain and the rate of progression of arthritis by correcting deformity, offloading the affected compartment and potentially allowing a return to heavy functional loading that could otherwise have jeopardised the survival of a joint replacement if performed instead [2].

On measuring the anatomic lateral distal femoral articular angle (aLDFA; normal values 81° ± 2°) [3], if the deformity is found to be within the distal femur, then that is the preferred site for osteotomy correction. When the deformity is mostly present in the proximal tibia, either due to abnormal bony anatomy or as a result of articular cartilage and meniscus loss, the deformity may be corrected on the tibial side with a lateral opening wedge high tibial osteotomy [4]. However, if the valgus deformity is greater than 12°, the distal femur is the preferred site of osteotomy as correction through the proximal tibia fails to correct the orientation of the joint line and can result in lateral subluxation of the tibia [5–7]. The results of closing wedge DFVO have been reported in several series along with cumulative survival rates of 64–87% (using conversion to TKA as an endpoint) [8–11]. The results of opening wedge DFVO for unicompartmental arthritis have been less comprehensively reported but several small case series exist [12–16]. Dewilde et al. reported a cumulative survival of 82% at 7 years using the Puddu plate and Zarrouk et al. reported 91% survival at 8 years using a Strelizia-type blade plate [13,16]. All authors reported statistically significant improvements in the outcome measures selected which included Knee Society Knee score [13,16], Lysholm score [12], KOOS score [15] and Oxford Knee score [14].

This study aims to report the survivorship of opening wedge DFVO along with comprehensive clinical and radiological assessment, using a series of validated outcome measures.

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http://dx.doi.org/10.1016/j.knee.2013.08.014

2. Methods

This study represents a case series of opening wedge DFVO, performed in a University based practise between 2001 and 2008. Preoperatively, all patients complained of lateral knee pain that was associated with a valgus deformity. There was no restriction on the grade of chondral wear in the lateral compartment but patients with Outerbridge grade 3 or 4 in the medial compartment were considered to be ineligible. The degree of correction to be achieved was determined preoperatively using the method described by Dugdale et al. [17]. This relies on the principle that in the valgus knee the mechanical axis passes to the lateral side of the midpoint of the tibial plateau. The aim of surgery was to correct this line to 48–50% across the width of the plateau from medial to lateral. The number of millimetres opening the correction was planned from the long leg alignment radiographs and confirmed at surgery with an image intensifier.

2.1. Surgical technique

The operative technique used throughout this study was an opening wedge technique as described by Puddu et al. [18] and subsequently modified according to the principles of using the TomoFix plate system.

Patients were positioned supine with the knee flexed to 30° using a combination of foot support and high laterally placed side support. Arthroscopy was performed to assess and address any intra-articular pathology as necessary. A 15 cm incision was made starting at 2 cm distal to the lateral epicondyle and extending proximally. The vastus lateralis was elevated off the septum and retractors inserted to hold the suprapatellar pouch of the knee anteriorly and to protect the posterior vessels posteriorly. A guide wire was inserted on the lateral aspect of the femur 3 cm proximal to the epicondyle, and directed to a point between the flare of the shaft and the medial epicondyle just proximal to the medial epicondyle. An oscillating saw was used to start the osteotomy, which was then developed with an osteotome ensuring that a medial bone hinge of at least 1 cm was preserved. Gentle varus stress was applied using either a wedge system or stacked osteotomes until a satisfactory position was achieved under an image intensifier at which point a plate was applied to achieve fixation. The choice of implant used changed throughout the study period. Prior to 2007 a conventional or locking femoral Puddu plate (Arthrex Inc., Naples, FL) was used. In the latter part of the study the TomoFix (Synthes, Switzerland) locking plate was preferred. Bone graft was not used unless the wedge opening was greater than 12 mm.

Patients commenced range of movement exercises on the first postoperative day. Patients were mobilised with a hinged total range of motion (TROM) locking knee brace (Donjoy, Guilford). This was locked in extension when walking but allowed free flexion when sitting. Patients remained toe touch weight bearing for four weeks, followed by a further four weeks of partial weight bearing.

All patients were assessed preoperatively and then at regular intervals postoperatively by means of plain radiographs, clinical assessment and validated patient-based outcome measures including the International Knee Documentation Committee (IKDC) score, the Knee Injury and Osteoarthritis Outcome Score (KOOS), SF-36, Lysholm score and Tegner score [19–22]. Survivorship of DFVO was defined by conversion to arthroplasty as an endpoint. Standardised weight bearing anteroposterior, lateral and 30° flexion weight bearing postero-anterior radiographs were taken. Long leg alignment radiographs were also taken to assess the mechanical axis pre- and postoperatively.

Statistical analyses were performed using Excel (Microsoft), the Kaplan–Meier analysis for cumulative survival (http://www.hutchon.net/Kaplan–Meier.htm) and the paired *t*-test for comparison of patient based outcome measures (http://www.graphpad.com/quickcalcs/ttest1.cfm).

3. Results

Twenty-two patients underwent opening wedge DFVO. One patient was excluded because the deformity was secondary to trauma and associated with a multi-ligament injury. Two patients were lost to follow-up; however, prior to this they were noted to be doing well but no scores were available. One patient did not wish to complete the patient based outcome measures and was therefore also excluded. The final study population therefore consisted of 18 patients in which 21 osteotomies were performed. Patient demographics and characteristics of the study population are detailed in Table 1. Five patients underwent additional procedures at the time of osteotomy. These included matrix-induced autologous chondrocyte implantation on the lateral femoral condyle (n = 1), meniscus allograft transplantation (n = 1), and microfracture (n = 3).

Four patients underwent arthroplasty for pain from progression of arthritis at 20, 25, 40 and 70 months respectively (mean of 3.3 years postoperatively). The cumulative survivorship of the osteotomies in this series using conversion to arthroplasty as an endpoint was 79% (95% CI 0.49 to 1.09) at 5 years (Fig. 1). The further analyses detailed below exclude the 4 patients converted to arthroplasty (except where stated) and are relevant to the remaining cohort of 17 osteotomies.

The mean preoperative weight-bearing axis passed through the tibial plateau at 75% (range 60–90%) from medial to lateral. The mean postoperative weight-bearing axis was 37% (range 10–58%) from medial to lateral. All patient reported outcome measures showed an improvement from baseline, however, only the IKDC and the pain subdomain of KOOS showed a statistically significant difference. Table 2 summarises the results.

Sixteen osteotomies underwent non-arthroplasty related further surgery. Ten underwent removal of metalwork due to localised discomfort or tenderness. Two patients underwent arthroscopic evaluation for persistent symptoms. In the first patient, microfracture was performed on a new lesion on the lateral femoral condyle and in the second patient no abnormality was detected, although they had a persistent effusion (meniscal allograft in situ), which eventually settled. The remaining four patients who required re-operation did so for the following complications; loss of correction (n = 2), plate mal-position in the presence of infection (n = 1) and non-union (n = 1).

4. Discussion

The key finding from this study is a cumulative survival DFVO of 79% (95% CI 0.49 to 1.09) at 5 years. This is in keeping with data from Dewilde et al. who reported cumulative survival of 82% at 7 years [13]. It is of interest to note that these survivorship figures for opening wedge DFVO are similar to those reported by Finkelstein et al. for closing wedge DFVO (83% at 4 years and 64% cumulative survival at 10 years) [9]. However, it should be noted that considerable heterogeneity between studies prevents any statistical analyses.

In terms of patient reported outcome, at latest follow-up (mean 4.5 years, range 1.6–9.2 years) the mean Lysholm, IKDC, and KOOS scores (all domains) had improved when compared to preoperative scores. However, only the improvements in the KOOS pain and IKDC scores reached statistical significance. The minimum perceptible clinical difference is thought to be between 8 and 10 points for the KOOS score and around 12 points for the IKDC score [20,23]. The KOOS pain score increased by 21.2 points and the IKDC by 16.2 points. These improvements are therefore not only statistically significant but also clinically relevant. However, five patients underwent additional surgery at the time of the index procedure (including MACI, microfracture, and meniscal transplant) and therefore some of the clinical improvement may be attributed to these further procedures.

The lack of statistically significant improvements in the KOOS sport and Tegner scores was surprising, because a return to high level function is often quoted as an advantage of osteotomy over arthroplasty [2]. Despite this, it should be noted that although the mean scores did not improve, one patient achieved a postoperative Tegner score of 9.

Table 1
Characteristics of the study population.

Number of patients	n = 18
Number of osteotomies	n = 21
Mean age at surgery (years)	41 (range 28–58)
Gender ratio M:F	12:9
Mechanical axis (% from medial to lateral)	
Preoperative	75 (range 60–90)
Postoperative	37 (range 10–58)
Mean follow-up (years)	4.5 (range 1.6–9.2)