High Tibial Osteotomy Using the 'Tomofix™' Plating System: Short Term Outcomes in Young Adults

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Abstract: Proximal tibial valgus osteotomy is one of the treatment options for painful medial compartment osteoarthritis and varus deformity of the knee. The aim of our study was to determine and quantify how much osteotomy altered symptoms from medial compartment gonoarthrosis. In addition we aimed to establish whether the Tomofix plating system would permit early weight bearing and achieve union without the use of bone grafts. We prospectively analysed our experience with medial opening wedge high tibial osteotomy using the Tomofix plate.

Thirty-five knees were included in the study. The mean age was 47 years (36-59 years). Mean duration of follow-up was 23 months (7-48 Months). All patients underwent medial opening wedge high tibial osteotomy using the Tomofix plating system. Data was recorded using the Oxford Knee score, the Knee Injury Osteoarthritis Outcome score and through review of pre and postoperative x-rays. Good outcomes were seen with statistically significant improvement of both scores.

There were two delayed unions, the remainder united without requirement for graft. There was improvement, in Oxford and Knee injury osteoarthritis scores. Correction of mal-alignment was seen in all cases. Early weight bearing was found to be permissible without risk of adverse event.

The Tomofix plate provided immediate stability and satisfactory healing of the osteotomy site without the need for bone graft. Good functional results were seen.

Keywords: Osteoarthritis, osteotomy, Knee.

INTRODUCTION

Osteoarthritis (OA) is a common problem and the risk of developing degenerative change increases with age [1]. What is more, an ageing population means that the incidence of osteoarthritis appears to be increasing [2]. However there is a significant cohort of younger patients with symptomatic OA in whom definitive management presents a real challenge. Initial management should be centred on non-operative measures, both pharmacological and non-pharmacological. If conservative therapy fails, surgery should be considered. Surgical treatments for knee OA include arthroscopy, cartilage procedures, osteotomy, and knee arthroplasty [3]. Determining which of these procedures is most appropriate depends on several factors, including the location, stage of OA, co-morbidities, age and activity level. Arthroscopic lavage and debridement is often carried out, but does not alter disease progression and has been shown to be of little long-term efficacy [4, 5]. If OA is limited to one compartment, unicompartmental knee arthroplasty or unloading osteotomy can be considered [6]. Medial opening wedge high tibial osteotomy (MOWHTO) is an established technique in the management of isolated medial compartment gonoarthrosis in the absence of ligamentous instability [7-9]. However, its use has decreased in recent years as a result of the popularity of unicompartmental arthroplasty. Some of the potential drawbacks associated with HTO have been limitations in weight bearing, necessity for bone graft augmentation and problems relating to implanted hardware. Newer locking plate designs, including 'Tomofix™' plate (Synthes) have sought to address some of these issues [10, 11]. The purpose of this study therefore was to investigate the efficacy of the HTO using the Tomofix plate, determine whether bone graft augmentation at the osteotomy site was necessary and to evaluate whether early weight bearing was possible without loss of alignment and with good functional outcomes.

PATIENTS & METHODS

Thirty-three consecutive patients (35 HTO's) undergoing MOWHTO with the TOMOFIX plating system between 2007 and 2010 were included in our study. There were no exclusions. Male to female ratio was 8.5:1. The mean age was forty-seven years (36-59 yrs). Minimum follow-up was six months with a mean follow-up of twenty-three months (7-48 months). All patients had osteoarthritis confined to the medial compartment, which was confirmed by a combination of plain radiography, arthroscopic assessment and MRI scan. All operations were performed by two consultant knee surgeons using a standard technique. Digital

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E-ISSN: 2313-0954/14

templating was not performed. The Tomofix plating system was used in all cases and no interpositional bone graft was used. Early weight bearing was permitted immediately post-operatively. Pre- and post-operative analysis of alignment was measured using standing long leg x-rays viewed on the AGFA Impax Web1000 5.1 PACS system.Measurements were made using the inbuilt tools (Figures **1** and **2**). Radiological union was assessed using plain x-rays in two plains. The rate of radiological union was recorded following analysis of post-operative plain radiographs. Functional data was prospectively collected using Oxford Knee Score (OKS) and Knee Injury Osteoarthritis Outcome Score (KOOS). Data was analysed using statistical functions of Microsoft excel database and significance testing between 2 groups was using the student t-test.

Figure 1: Pre-operative analysis of alignment.

Figure 2: Post-operative analysis of alignment.

RESULTS

One patient was untraceable and therefore lost to follow up yielding a cohort for analysis of 32 patients and 33 HTO's. Thirty-one osteotomies united without complication (94%), an example of which is depicted in Figure **3**. Two patients had incomplete union of the osteotomy site (6%). In both instances union from

lateral to medial halted before the medial cortex was reached. Both subsequently underwent additional bone grafting using cancellous autograft with the plate left in place and united satisfactorily.

Figure 3: United Osteotomy.

Using full length x-rays, pre and postoperative mechanical axis alignment was measured. The mechanical axis was brought laterally in cases. Details of mean alignment and ranges are shown in Table **1**.

Significant improvements in Oxford Knee Score and Knee injury Osteoarthritis Score were seen following the procedure. The mean scores are detailed in Table **2** along with relevant P-values. Complete data sets are listed in Table **3**.

There were no instances of metal failure throughout our study and no other complications.

DISCUSSION

Medial opening wedge high tibial osteotomy using the Tomofix plate has now been shown in a number of studies to be a safe procedure allowing early total weight bearing [12] with a low complication rate [13, 14]. Furthermore high rates of union have been achieved without the use of interpositional bone grafting [15]. Our study supports these results. In addition, we have shown that early full weight bearing can be achieved from day 1 post-op without collapse at the osteotomy site or increased non-union rates. Our prospective analysis has also shown that consistent increases in functional results can be achieved in as little as 6 months. Offloading of the degenerate compartment help to reduce symptoms to an acceptable level thus delaying the need for replacement arthroplasty. The excellent functional results seen with this technique make it a good option in younger, active patients with a higher demand in whom there might be concerns regarding increased wear rate in joint arthroplasty surgery [16]. Following HTO, subsequent revision to primary total knee replacement has not been shown to lead to a significant change in level of function [17]. Plate removal may be considered once full radiological union has been achieved in order to minimise the technical challenges of knee replacement surgery in this group. Our study echoes the published literature highlighting

Table 1: Alignment

Mean Pre-op alignment	Mean Post-op alignment	Mean change in alignment.
6.3° Varus (0.8-12.8)	1.3° Valgus (-1-5.6)	8° (3.3-16.3)

Table 2: Functional Scores

	Mean Pre-op	Mean Post-op	P-Value
Oxford Knee Score.	21 (7-47)	38 (16-48)	p<0.05
Knee Injury Osteoarthritis Outcome scores	38.7 (8.3-91.5)	74.5 (25-97.6)	p< 0.05

Table 3: Complete Data

Patient	Age	Follow up	Varus Pre	Varus post	Correction	Pre OKS	Post OKS	Pre KOOS	Post KOOS
1	45	19	7.5	-0.2	7.7	17	30	35.1	53.6
2	48	21	12.4	-0.1	12.5	10	34	32.7	55.4
3	59	24	8.5	-0.3	8.8	7	28	8.3	56.5
4	41	25	8.5	-0.7	9.2	42	45	63.7	75
5	41	25	10	0.5	9.5	15	42	17.9	87.5
6	54	40	5	0.3	4.7	16	39	17.5	73.2
7	49	48	7.4	-1.1	8.5	8	28	25	66
8	35	7	5	-3.9	8.9	33	33	62.8	53.6
9	47	17	6.2	-0.4	6.6	29	43	58.9	85.1
10	25	35	5.3	-0.9	6.2	24	43	55.4	89.9
11	38	9	9.9	1	8.9	30	47	60.7	90.5
12	49	20	5.3	-2.8	8.1	12	43	14.3	73.2
13	44	39	8.7	-1.3	10	16	46	26.8	85.1
14	48	22	6.1	-1	7.1	26	36	40.5	66.1
15	48	8	6	-0.6	6.6	25	39	41.1	70.2
16	47	26	4.7	-2.3	7	18	35	29.8	83.3
17	36	22	12.8	0.7	12.1	30	47	61.9	95.2
18	41	15	3.6	-2.6	6.2	32	48	62.5	97
19	48	15	3.1	-0.2	3.3	17	35	23.2	78.6
20	42	11	4.5	-3.4	7.9	16	36	25	76.8
21	54	19	9.5	-2.7	12.2	32	46	48.8	97.6
22	54	25	0.8	-6	6.8	12	37	17.5	63.1
23	49	40	6.3	-0.1	6.4	22	35	31	76.2
24	38	21	2.1	-4.7	6.8	8	23	17.9	60.7
25	55	34	11.4	-4.9	16.3	31	20	62.8	34.5
26	56	31	7	-0.3	7.3	28	47	55.4	93.5
27	52	26	5.7	-3.4	9.1	18	39	32.1	86.3
28	51	34	4.4	1.1	3.3	10	32	23.8	63.7
29	57	27	5.6	-3.3	8.9	16	43	22.6	90.5
30	53	27	5.1	-0.6	5.7	14	16	25.6	25
31	56	12	2.7	-0.6	3.3	47	47	91.5	91.5
32	42	14	6.1	-5.6	11.7	22	43	39.3	85.1
33	54	25	1.2	-4.2	5.4	26	39	45.8	77.4

those risk factors with increased rates of delayed or non-union. Suggested risk factors include smoking and those with an increased BMI [18], as well as surgical technique and fracture of the lateral cortex, which increases rates of non-union as well as risking loss of correction [19]. Where fracture of the lateral hinge does occur the Tomofix has been shown to convey greater stability than alternative fixation methods [20].

CONCLUSION

This study confirms that medial opening wedge high tibial osteotomy is a safe and effective technique for the management of isolated medial compartment gonoarthrosis. The Tomofix plate conveys good stability and resistance to load permitting early weight bearing without the requirement of graft augmentation.

The authors appreciate the numbers included in this study are relatively small and the follow up period is short in some cases. However, the role for osteotomy about the knee is well established and we have highlighted that using this technique good results are achievable without graft donor site morbidity and permissive weight bearing.

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Received on 26-06-2014 Accepted on 07-07-2014 Published on 17-12-2014

DOI: http://dx.doi.org/10.12974/2313-0954.2014.01.02.2