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Dr. Ranganatha B Thimmegowda
MS, DNB, Assistant Professor,
ESIC Medical College, PGIMS
and Model Hospital,
Rajajinagar, Bengaluru,
Karnataka, India

Dr. Purushotham VJ
MS, Associate Professor,
Bangalore Medical College and
Research Institute, Bengaluru,
Karnataka, India

Dr. Sandeep Patel
MS, DNB, Assistant Professor,
PGIMER, Chandigarh, India

Sequential soft tissue release and unconstrained TKA implants in severe varus deformity- Prospective study in 75 knees

Dr. Ranganatha B Thimmegowda, Dr. Purushotham VJ and Dr. Sandeep Patel

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Abstract

Background: Patients with severe Varus knees is not uncommon in developing countries, and TKA offers good results. The type of release required and need for constrained prosthesis needs to be defined.

Purposes-1) Assess the adequacy of sequential medial soft tissue release in correcting the varus deformity in severe primary varus knees. 2) Assess the need for using constrained type of components.

Patients and methods- 75 primary severe varus knees (≥ 20 degrees) in 52 patients presenting to us over 3 years were divided into 4 groups based on severity of varus. Group A (20-25 degree) had 31 patients, Group B (26-30 degrees) had 31 patients, Group C (31-35 degree) had 8 patients and Group D (36- 40 degree) had 5 patients. All patients were evaluated for the type of release required, the type of defect reconstruction needed and the need for constrained prosthesis intraoperatively. KSS scores were documented preoperatively and at final follow up.

Results: In group A, 27 patients (87%) required type 1 release and the rest 4 patients (13%) required type 2 release. In 19 patients defect was reconstructed by use of cement and in 4 patients cement +screw was used. 8 patients did not have defect after tibial cuts and balancing. In Group B, 12 patients (39%) required type 1 release and 19 patients (61%) required type 2 release. The defect was reconstructed with cement in 7 patients, with cement+screw in 14 patients, with bone graft in 8 patients and remaining 2 patients required augments. In group C, 2 patients (25%) needed type-3 release, 5 patients (62.5%) needed type 2 release and one patient (12.5%) needed type 1 release. The defect was reconstructed with augments in 2 patients, with bone graft in 5 patients and with cement+screw in one patient. Of the 5 patients in group D; 2 patients (40%) required type 4 release and 3 patients (60%) required type 3 release. All the 5 patients required augments for reconstruction of the tibial defect. None of our patients required constrained prosthesis.

Conclusion: Most patients with severe varus deformities can be managed successfully with sequential medial soft tissue release and defect reconstruction. With the increasing varus deformity, the defect reconstruction method increased from cement to cement+screw to bone graft and finally augments in severe cases. A CR/PS type of implants can be used in almost all cases and additional constraints and hinged implants are rarely required.

Keywords: Severe Varus Deformity, Total Knee Arthroplasty, Unconstrained Implants, Medial release

Introduction

Total knee arthroplasty is one of the most successful surgeries in the field of orthopaedics. In spite of its success, it is not uncommon to see patients with severe deformities, especially in developing countries. Lack of expert medical care, ignorance, fear of surgery and seeking care from native bonesetters or alternative forms of medicine could be few reasons for delayed presentation.

Varus deformities are the commonest type of deformities encountered in such a situation. A severe varus deformity (more than 20 degrees) poses challenge in terms of the type and extent of release required and the flexion extension gap balancing of the knee. Additional constrained or a hinged type of knee replacement components might often be required (1-4). Flexion extension gap balancing is a crucial factor in determining long term success of knee replacement. Instability post TKA is one of the major reasons responsible for early revisions and poor outcomes. Majority of the studies advocate the use of constrained or a hinged type of

Correspondence

Dr. Purushotham VJ
MS, Associate Professor,
Bangalore Medical College and
Research Institute, Bengaluru,
Karnataka, India

prosthesis for such deformities and it seems an easier, although an expensive option in such cases [1-4]. There are only a few studies involving a large number of cases, where a regular type (PS or CR) of prosthesis has been used to manage such deformities [5, 6]. In our Prospective study, we aimed to address the following. 1) Assess the adequacy of sequential medial soft tissue release in correcting the varus deformity in severe primary varus knees. 2) Assess the need for using constrained type of components.

Patients and Methods

75 primary severe varus (more than 20 degrees) knees in 52 patients between the age group of 52 - 76 years underwent total knee arthroplasty (TKA) from January 2010 to September 2013. 29 patients had unilateral TKA and 23 patients had bilateral TKA. Among the 29 patients who underwent unilateral TKA, 15 had a contralateral involvement with less than 20 degree varus, for which TKA was done. One patient had a windswept deformity with valgus on the opposite side for which a TKA was done. 13 patients had mild to moderate varus osteoarthritis on the other side, which were managed conservatively. 15 patients had an associated flexion deformity of more than or equal to 20 degrees. There were 32 female and 20 male patients. All patients had osteoarthritis as their diagnosis.

All patients were operated by the same surgical team. Posterior stabilized components (Stryker) were kept as the first option and Revision components with constrained poly liner was kept as back up for all Cases. Rotating hinge knee components were kept ready for the most severe deformities with extensive bone loss. All patients underwent step wise sequential medial soft tissue release consisting of deep MCL, posteromedial release, superficial MCL and pes anserinus (Table-1). Bony defects were assessed and were managed with the cement, cement screw construct (CSC), bone grafts or metal augments (Table-2). Stem extenders were used wherever necessary.

A standard technique was followed in all cases. Degree of correctability of varus deformity was noted in all cases by applying maximum valgus stress at the knee with the knee in maximum extension and the limb in neutral rotation. Type of release was planned accordingly. Stage 1 release consisting of deep MCL and anteromedial capsule was done as a part of exposure in all cases and further releases done based on severity of varus and its correctability. Osteophytes were removed at various stages of exposure and bony cuts were carried out. Tibial first resection using extra medullary jig was carried out. Distal femoral resection was done in valgus angles of 4 to 8 based on preoperative assessment of full length scanograms. Intramedullary technique was used for distal femoral resection in all cases, except 2 cases with severe bowing of femur. In these cases, a combined intra and extra medullary technique using a short intra medullary rod and a C-Arm Image Intensifier to locate the center of the femoral head was used. Rotation of the femoral component was decided using all the techniques (Whiteside's Line, Epicondylar axis and posterior condylar reference). A combined anterior and posterior referencing was used for sizing of femur. A minimal notching of only the lateral cortex was sometimes accepted. Posterior stabilized implants were used in all cases. An additional 2mm tibial resection was done wherever possible. Downsizing and lateralizing of tibial components were done wherever possible. None of the patients underwent patellar resurfacing.

Results

The results were analysed as to

- 1) Type of release required
- 2) Management of defects
- 3) Requirement of additional constraints or a hinged type of prosthesis.

52 (75 knees) patients in the age group of 52 to 76 years underwent total knee arthroplasty using a posterior stabilised knee system (Stryker). The mean age of the patient was 64 years. Preoperative varus ranged from 20 to 40, with a mean of 27. Preoperative range of motion ranged from 50 -130 and the mean was 106.

40 patients required type 1 release, 28 patients required type 2 release, 5 patients type 3 release and 2 patients required type 4 release. In 26 patients the bony defect was reconstructed using cement, cement screw construct (CSC) was used in 19 patients. 13 patients required bone graft for the management of the defect and augments were used in 9 patients. In 8 patients there was no defect after the proximal tibial cut was made. Stem extender was used in 23 cases.

The data was further divided into 4 varus subgroups, comprising of group A (20-25 degrees), group B (26-30 degrees), group C (31-35 degrees) and group D (36-40 degrees). These subgroups were further analysed. In group A, 27 patients (87%) required a type 1 release and 4 (13%) patients required type 2 release. In group B, 19 patients (61%) required type 2 release, followed by type 1 release in 12 patients (39%). In group C, 5 patients (63%) required type 2 release, 2 patients (25%) type 3 release and 1 patient (12%) type 1 release. In group D, 3 patients (60%) required Type 3 release and 2 (40%) patients required type 4 release. All patients in group A and group B, varus of less than or equal to 30 were corrected by a type1/ type 2 release. (Table-3)

With regard to defect reconstruction, 19 patients (61%) in group A needed cement for reconstruction of the defect, whereas 4 (13%) patients required cement screw construct. 8 (26%) patients in group A were left with no defect after the standard or the additional tibial cut. In group B Cement screw was the commonest type of defect reconstruction in 14 patients (45%), 8 (26%) patients required bone graft, 7 (23%) patients required cement and 2 (6%) patients required metal augments. In group C bone graft was the most common method of defect reconstruction in 5 patients (63%). 2 (25%) patients required augments and 1(12%) required CSC. All patients in group D required metal augments for defect reconstruction.

None of the patients required a constrained polyethylene or a hinged type of prosthesis. None of the patients required a ligament advancement procedure or an epicondylar osteotomy.

Postoperative range of motion ranged from 70 -130, with the average being 105. 5 patients had less than 90 of movement and 4 patients had a residual flexion deformity of 10. The minimum follow up was for 24 months and the maximum follow up was for 60 months. The mean follow up was about 39 months. Mean postoperative KSS Knee score increased from 28.9 to 89.8 and KSS function score increased from 30.6 to 81.1 (Table-4). 66 patients had postoperative alignment of within 3 degree of mechanical axis. There were 9 outliers with 8 patients having more than 3 degree varus malalignment and 1 patient having more than 3 degree valgus malalignment. None of the patients had radiological evidence of lysis or loosening of implant nor required revision till their last follow up.

Table 1: Type of medial soft tissue releases done.

Stage 1 Release	Deep Mcl And Medial Capsule
Stage 2 Release	Stage 1 + Posteromedial Release
Stage 3 Release	Stage 2 + Superficial Mcl
Stage 4 Release	Stage 3 + Pes Anserinus

Chart showing the type of releases required

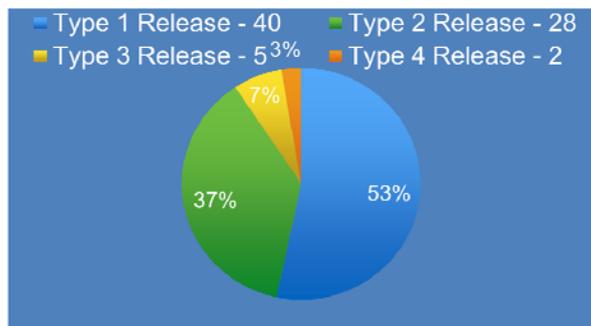


Table 2: Management of defects

Defect - Less Than 5 Mm	Cement
Defect 5- 9 Mm	Cement Screw Construct
> 10mm With Less Than 50% Of Medial Condyle	Bone Graft
> 10mm With More Than 50% Of Medial Condyle	Metal Augments

Chart showing the management of defects

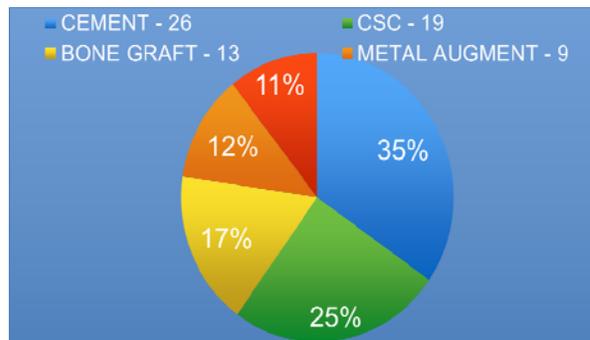


Table 3: Showing the type of release and defect reconstruction in varus subgroups.

Severity of Varus	Release				Defect Reconstruction				
	Type-1	Type-2	Type-3	Type-4	CEMENT	CEMENT SCREW	BONE GRAFT	AUGMENT	NIL
A (20-25) n=31	N=27 (87%)	N=4 (13%)	0	0	19	4	0	0	8
B (26-30) n=31	N=12 (39%)	N=19 (61%)	0	0	7	14	8	2	0
C (31-35) n=8	1	5	2	0	0	1	5	2	0
D (36-40) n=5	0	0	3	2	0	0	0	5	0
TOTAL n=75	40	28	5	2	26	19	13	9	8

Table 4: Showing Preop and Post op Alignment, ROM and KSS scores in various subgroups.

Group	Pre- Op				Post- Op			
	Alignment	ROM	KSS Knee Score	KSS Functional Score	ALIGNMENT	ROM	KSS Knee Score	KSS Functional Score
A	22.25	118 (80-130)	39.8	41.9	0.38 (4 valgus - 3 varus)	112 (70-130)	93.3	85.5
B	28.78	103 (50-130)	26.9	27.6	0.67 (3 valgus - 5 varus)	101(70-120)	88.3	80.7
C	34	93 (70-120)	10.4	7.5	2.87 (2 valgus - 5 varus)	94 (70-110)	85.8	69.4
D	39	86 (60-100)	4.4	17.0	3.8 (2 valgus - 6 varus)	92 (80-100)	85.4	76.0
OVERALL	27.3	106 (50-130)	28.9	30.6	1 (4 valgus - 6 varus)	105 (70-130)	89.8	81.6



Fig 1.a: Pre Op Radiographs showing Varus with bone loss;



Fig 1b: Post Op Radiograph AP View, defect reconstructed using Bone graft and screw;



Fig 1c: Post op Radiograph Lateral View



Fig 2a: Pre-Op Radiograph AP view showing severe varus in B/L Knees;

Fig 2.b: Post-Op Radiograph AP view, Rt Knee- defect reconstructed with metal wedge and stem extender, Lt knee- Screw Cement construct



Fig 3.a: AP radiograph showing severe Varus;

Fig 3.b: Post Op Radiographs with defect reconstructed with metal wedge and stem extender



Fig 4.a: Pre Op Clinical Photograph showing severe Bilateral Varus



Fig 4.b: Post Op Clinical photograph

Discussion

Many patients in developing countries seek late medical attention for knee osteoarthritis and it is not uncommon to see patients with grotesque deformities. Total knee arthroplasty in severe varus deformity is a challenging procedure, which requires meticulous technique of medial release to create a balanced flexion and extension gap. Under correction leads to persistent deformity, whereas overcorrection causes instability, both of this may lead to early failure. An easier method of managing such cases is to use a Constrained condylar knee (CCK) or a rotating-hinged knee (RHK). These prostheses have high risk of failure in medium to long term and hence are better to restrict their use in the elderly population [1, 7, 8]. Increased polyethylene wear, increased potential for aseptic loosening, increased surgical time, higher stress at interface, need for more bone removal at femoral notch, high prosthesis cost are some of the disadvantages and concern [9, 10, 11]. Pang *et al* [12] have noticed significant joint

line elevation in constrained knees compared to unconstrained knees in valgus knees. However with the evolving technology of constrained knees, the newer CCK designs and recent works show good results in complex primary cases [2, 3, 13]. Whenever possible, the recommendation that minimum possible constraint required to achieve stability should be followed [1, 11, 14]. We have been able to manage majority of our severe varus deformity by conventional PS type of TKA implants. In the recent literature, there are quite a good number of studies showing good results with either a CR/PS type of implant [5, 6, 15]. The present study was carried out to look for the efficacy of sequential medial soft tissue release and the requirement of prosthesis with a higher degree of constraint.

Before offering surgery in such cases, it is useful to consider the rate of success of the procedure. There are few studies looking at the results of TKA in severe deformities in comparison with the lesser deformed cases. Lee *et al*, [16] concluded that preoperative varus do not have detrimental effects on the longevity and clinical outcome and such cases can be successfully managed. Matsumo *et al* [17] looked at the influence of intraoperative soft tissue balance and concluded that even in severe varus knees, gap balancing can be adjusted using PS TKA. On the other hand, there are studies which say that there is an increased risk of failure in patients with significant preoperative malalignment.

The classic techniques of extensive medial soft tissue release for varus deformity by Insall, where in the superficial MCL is subperiosteally released progressively till the length of the medial soft tissues become equal to that of the lateral side [18]. This technique sometimes requires that complete release of all the structures on the medial side, carrying a risk of over correction and instability. Many authors have described a sequential step by step release of the medial structures to prevent over correction and is evolving as a standard procedure [19, 20]. Down sizing and lateralising of the tibial component, along with the resection of the uncovered medial bone has been described for the correction of the severe varus deformity [21-23]. This method causes effective lengthening of the medial structures and thereby helps in correction of the deformity. Dixon *et al* [21] had excellent clinical and radiological results in patients with severe varus using this technique. Niky *et al* [22], in a study of 39 severe various knees, could achieve gap balancing by reduction osteotomy and lateralisation of tibial component with the release of deep MCL alone in 20 knees. They noticed that Flexion gap imbalance at 90° could be reduced by 1.7° and 2.8° for 4-mm osteotomy and 8-mm osteotomy, respectively. Mullaji *et al*. [23], in their attempt at quantification of the reduction osteotomy, found out that there was 1 degree correction of varus in extension for 2mm of resection. Both described this procedure to be effective with predictable results.

In our study, 40 patients (55%) were corrected by Type 1 release alone, 28 patients (37%) required Type 2 release and only 10% of patients required a Type 3/4 release. Most knees with severe varus could be corrected by releasing the deep MCL with/without a posteromedial release. All patients within 20-30 degrees of varus were managed with type 1/2 release and type 3/4 release was required only in cases with more than 30.

Posteromedial bone loss is commonly associated with severe varus deformities. Various classifications have been associated described for the assessment of bony defects. We classified the defects into contained and uncontained ones. All contained defects were managed with morcelised autogenous

bone grafts. Uncontained defects were assessed based on the depth and surface area of the defect. Defects of less than 5mm in depth were managed with bone cement, defects between 5 and 9mm were managed using cement screw construct. For Defects of more than 9mm, the percentage of involvement of medial condyle was assessed. For defects with less than 50% involvement, bone grafting was done and for those with more than 50% involvement metal augments were used. In our study, 11% (8 patients) had no defect after the tibial cut was done. 60% of patients had a defect of less than 10mm, which was managed with cement/CSC. 29% of patients required bone graft or metal augments. In group A most patients required cement, in group B most patients required CSC. In group C, most cases required a bone graft and in group D most cases required metal augments for management of bone defects.

66 patients had postoperative alignment of within 3 of mechanical axis. 9 patients were outliers, out of which 8 patients had > 3 varus and 1 patient had > 3 valgus. Most studies show a tendency towards varus malalignment in patients with severe varus. None of the patients with malalignment had lysis, loosening or revision within this short period of follow up.

Our study has few limitations. The follow up period of 2 years is too short to assess the effectiveness of the unconstrained prosthesis, as there might be delayed implant failures, especially on the tibial side. The study is not a randomised controlled trial comparing constrained and unconstrained type of prosthesis. It also does not compare the various types of releases like the complete release, sequential release, reduction osteotomy and down sizing of the tibial component and pie crusting technique of MCL release.

Conclusion

Most patients with severe varus deformities can be managed successfully with a sequential medial soft tissue release and defect reconstruction. Lateralising and downsizing of the tibial components with reduction osteotomy helps in managing such cases with minimal releases. Complete release of superficial MCL and Pes tendons are rarely required. A CR/PS type of implants can be used in almost all cases and additional constraints and hinged implants are rarely required.

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