Autologous bone grafting plus bio-absorbable pin fixation for medial tibial defects in total knee arthroplasty

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## Introduction

<table>
<thead>
<tr>
<th>Bone defects</th>
<th>≤5mm</th>
<th>5~10mm</th>
<th>&lt;10mm</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Treatment</strong></td>
<td>autologous bone grafting</td>
<td>modular wedge</td>
<td>metal augments + autologous bone grafting</td>
</tr>
</tbody>
</table>

Franceschina et al. (1999) ¹)

Treatment of medial tibial defects in total knee arthroplasty (TKA)
- Autologous bone grafting
- Metal augments

## Purpose

The purpose of this study was to evaluate radiographic features and clinical outcomes of autologous bone grafting plus bio-absorbable pin fixation for medial tibial defects of ≥10 mm depth in TKA.

SHIN KATO, MD, PhD
I have no financial conflicts to disclose.
Materials and Method

Five patients with medial tibial defects of ≥10 mm depth who underwent primary TKA with autologous bone grafting plus bio-absorbable pin fixation were included in this study.

<table>
<thead>
<tr>
<th>Patients</th>
<th>5 (1 male, 4 female)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age</td>
<td>67 (56-77)</td>
</tr>
<tr>
<td>Diagnosis</td>
<td>5 osteoarthritis</td>
</tr>
<tr>
<td></td>
<td>(1 patient complicated by pigmented villonodular synovitis)</td>
</tr>
<tr>
<td>Implant</td>
<td>PFC-ΣPS 4 patients TC3 1 patient (DePuy)</td>
</tr>
<tr>
<td></td>
<td>(the use of stem extension in all TKAs)</td>
</tr>
<tr>
<td>Follow-up</td>
<td>3.6 years (1-5)</td>
</tr>
</tbody>
</table>

Bio-absorbable pin

Super FIXSORB (DePuy Synthes)
(This constitutes unsintered hydroxyapatite particles/poly l-lactide (u-HA/PLLA) composites)
**Operation**

1. Femoral bone was cut first with measured resection technique, the autologous bone was used a block of resected cancellous bone that was made by femoral component box.

2. After medial tibial bone defects were cleaned up and obliquely cut sharp to tibial alignment, tibial bone was cut vertical to tibial alignment.

3. After the autologous bone was temporarily fixed to medial bone defects with Kirschner wire, tibial bone was re-cut.

4. The autologous bone was fixed with bio-absorbable pins.

   (Super FIXSORB @DePuy Synthes)

5. After positioning of the components is confirmed by trial, all components were implanted using cement.


**Rehabilitation**

postoperative 1 day～ ROM ex, and FWB gait ex

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**Evaluation items**

- Depth of bone defect (mm) (Michael et al.\(^2\))
- Type of bone defect (Engh et al.\(^3\))
- Japanese Orthopedic Association (JOA) Score
- Range of motion (ROM) (°)
- Femoro-tibial angle (FTA) (°)
- Bone union, bone absorption, collapse of grafted bone
# Results

<table>
<thead>
<tr>
<th>Depth</th>
<th>19.9mm (12.5-30.4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Asymmetrical loss in all patients</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Preoperatively</th>
<th>Final follow up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexion</td>
<td>107.0°</td>
<td>116.3°</td>
</tr>
<tr>
<td>Extension</td>
<td>-17.0°</td>
<td>-6.3°</td>
</tr>
<tr>
<td>FTA</td>
<td>193.0°</td>
<td>180.0°</td>
</tr>
<tr>
<td>JOA Score</td>
<td>48.8</td>
<td>80.0</td>
</tr>
</tbody>
</table>

| Bone union       | 5/5            |
| Bone absorption  | 3/5 (partial bone absorption in 3 patients) |
| Collapse         | 0/5            |
| Non union        | 0/5            |
**Case 1**

72Y Male, OA

| Depth       | 17.2mm |

<table>
<thead>
<tr>
<th>Preoperatively</th>
<th>Final follow up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexion</td>
<td>135°</td>
</tr>
<tr>
<td>Extension</td>
<td>-10°</td>
</tr>
<tr>
<td>FTA</td>
<td>197°</td>
</tr>
<tr>
<td>JOA Score</td>
<td>75</td>
</tr>
</tbody>
</table>

Preoperatively  Po.0d  Po.1M  Po.6M  Po.1Y  Final follow up

[Images of x-rays showing knee joint before and after surgery.]
## Case 2

<table>
<thead>
<tr>
<th></th>
<th>Preoperatively</th>
<th>Final follow up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexion</td>
<td>85°</td>
<td>110°</td>
</tr>
<tr>
<td>Extension</td>
<td>-25°</td>
<td>-10°</td>
</tr>
<tr>
<td>FTA</td>
<td>195°</td>
<td>176°</td>
</tr>
<tr>
<td>JOA Score</td>
<td>45</td>
<td>80</td>
</tr>
</tbody>
</table>

77Y Female, OA

Depth
19.7mm

Preoperatively | Po.0d | Po.1M | Po.6M | Po.1Y | Final follow up
--- | --- | --- | --- | --- | ---
Preoperatively | | | | | |
Discussion

Autologous bone grafting

Merit
Bone preservation
Biological compatibility

Majima et al. (2006) 4)
17 patients with tibial defects of $\geq 3\text{cm}^2$
  Union : all cases  Collapse : 1  Absorption : 2

Sugita et al. (2011) 5)
After tibial bone was cut, 30 patients with tibial defects of $\geq 10\text{mm}$ depth
  Union : all cases  Collapse : 0  Absorption : 0

This study (2019)
5 patients with medial tibial defects of the average of 20 mm depth
  Union : all cases  Collapse : 0  Absorption : 3

Autologous bone grafting is one of good treatment option. But it is necessary to careful follow up because of there is possibility that collapse of grafted bone or bone absorption could be occurred.
There are some reports about the collapse of the grafted bone, non-union and delay of rehabilitation in autologous bone grafting.

Suguro et al. (2003) 6)
The use of a long stem is imperative to accommodate tibial bone defects greater than 2 cm.
Majima et al. (2006) 4)
Use long stem considering initial fixation strength for bone defect more than 1/3 width of tibia.
Brooks et al. (1984) 7)
By using the long stem, the axial load on the proximal part of the cortical bone can be reduced by 30%.

✓ Strong fixation of the grafted bone by bio-absorbable pins
✓ Decreased axial load on the proximal tibia by using the stem extension

Post-operative rehabilitation can be performed as with normal TKA. There was no collapse of the grafted bone and good clinical results were achieved.
Takagi et al. (2010) 8)
Good short-term results using a stem extension with metal wedge for tibial bone defects greater than 20 mm.

Treatment of tibial bone defects (our hospital)
~ 5mm  Cementing
5~20mm  Autologous bone grafting + stem extension
20mm ~  metal wedge + stem extension
(If it is possible to use the autologous bone grafting with block,
   Autologous bone grafting + stem extension )

Limitation
• Small number of cases
• Short-term follow up
Conclusion

- We evaluated radiographic features and clinical outcomes of autologous bone grafting plus bio-absorbable pin fixation for medial tibial defects of ≥10 mm depth in TKA.

- The advantage of autologous bone grafting plus bio-absorbable pin fixation is high biocompatibility, bone preservation and capable of full weight bearing gait at early postoperative period.

- It is necessary to careful follow up because of there is possibility that collapse of grafted bone or bone absorption could be occurred.
1) Franceschina, M. J., Swienckowski, J. J.
Correction of varus deformity with tibial flip autograft technique in total knee arthroplasty.

Tibial tray augmentation with modular metal wedge for tibial bone stock deficiency.

3) Engh, G.A., Parks, N.L.
The use of a bone defect classification system in revision total knee arthroplasty.

4) Majima, T, et al.
Total Knee Arthroplasty with Massive Bone Graft for Tibial Bone Defect in Rheumatoid Arthritic Knee

5) Sugita, T, et al.
Evaluation of autologous impacted bone graft for tibial defects in total knee arthroplasty

6) Suguro, T
The Management of Severe Proximal Tibial Bone Loss in the Total Knee Arthroplasty

7) Brooks, P. J., Walker, P. S., Scott, R. D.
Tibial component fixation in deficient tibial bone stock.

Clinical results of total knee arthroplasty using metal wedge augmentation for tibial bone stock deficiency