



# Midterm follow-up of closing wedge high tibial osteotomy with upper tibiofibular joint capsulotomy

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## Abstract

Closing wedge high tibial osteotomy is a popular surgery for correcting varus knee in symptomatic patients. One of the major drawbacks of this method is complications related to fibular osteotomy. This study describes pearl and pitfalls of closing wedge high tibial osteotomy with upper tibiofibular joint capsulotomy, avoiding fibular osteotomy and proposes that it has less complications and better results. Closing wedge high tibial osteotomy with upper tibiofibular joint capsulotomy was carried on 34 knees (19 patients) between September 2011 and June 2015 (thirteen males and six females). Operated men were between 19 and 38 years with mean 21 years. Operated women were between 23 years and 51 years. Considering that only one woman was 23 years old and the other four were between 45 and 51, better results and fewer complications were obtained in younger individuals with less body mass index and milder deformities. As a conclusion, when selecting patients, it is vital to stick to inclusion criteria. When in two or more factors, the patient is close to upper limits of inclusion criteria, unsatisfactory outcomes might be expected.

**Keywords** Closing wedge · High tibial osteotomy · Fibular osteotomy · Varus deformity · Peroneal nerve palsy

## Introduction

High tibial osteotomy is considered to be one of the most accepted procedures in correcting varus deformity of the knee, off-loading of the medial compartment of the knee and decelerating degenerative joint process [1–4].

It is basically supposed that any major deviation from normal weight bearing axis, leading to uneven weight force distribution, produces pain and predisposes the knee joint to degenerative changes [3, 4].

So high tibial osteotomy is considered to be an acceptable procedure to alleviate pain in a painful varus knee, postpone degenerating changes in a progressive varus deformity and decelerate destruction of a medial knee joint arthrosis [3–5].

Proper patient selection, preoperative planning and suitable surgical technique are keys to desirable outcome.

The ideal candidate for high tibial osteotomy is a young-to-middle-age patient with a painful varus knee and a documented overloaded medial compartment on a plain

radiography or a middle-aged patient with mild-to-moderate uni-compartment medial degenerating joint disease [1–4].

There is general consensus on poor prognostic factors and contraindications in high tibial osteotomy.

Knee ROM < 90°, flexion contracture > 15°, other compartments involvement, rheumatoid arthritis, more than 20° of correction required, more than 10 mm of lateral subluxation, severe degenerative changes (Ahlback grade III and more) and considerable lateral thrust [1–4].

Preferred surgical technique could be a matter of debate but actually there is no significant difference between various techniques and it is a matter of the surgeon experience and preference.

Reported complications of closed high tibial osteotomy includes peroneal nerve injury, vascular injury, nonunion of the osteotomy site, avascular necrosis of the proximal segment, iatrogenic tibial plateau fracture, nonunion of the fibular osteotomy, recurrence of varus deformity and deep vein thrombosis [6].

Some of the major drawbacks of closing wedge high tibial osteotomy are peroneal nerve injury and nonunion of the fibular osteotomy [7].

In order to avoid mentioned complications and minimize time of the surgery and bleeding volume, the author

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performed closing wedge high tibial osteotomy without fibular osteotomy and instead accomplished the correction with upper tibiofibular joint capsulotomy.

## Materials and methods

Closing wedge high tibial osteotomy with upper tibiofibular joint capsulotomy was carried on 34 knees (19 patients) between September 2011 and June 2015 (thirteen males and six females). Operated men were between 19 and 38 years with mean 21 years. Operated women were between 23 years and 51 years, considering that only one woman was 23 years old and the other four were between 45 and 51.

Prior to this study, the surgeon (author) had the experience of closing wedge high tibial osteotomy with fibular osteotomy employing various techniques including zigzag osteotomy, dome osteotomy, closing wedge with fibular osteotomy at the junction of middle to distal third and closing wedge with osteotomy at the upper tibiofibular joint, with different types of fixations from staple to locking plate.

Including criteria were painful varus knee, degenerative changes or overloading of the medial compartment demonstrated on simple radiography and good knee ROM.

Excluding criteria were severe varus deformity (more than 20° correction required), severe degenerative changes (Ahlback grade III and more), major ligamentous instability, rheumatoid arthritis, degenerative changes in other compartments of the knee, considerable lateral thrust and more than 1 cm lateral subluxation, previous osteotomy about the knee.

Considering the maximum wedge that could be removed in closing wedge high tibial osteotomy, it is not easy to achieve more than 20° of correction.

All patients complained of pain without acceptable response to more than 6 months of non-operative therapy.

Prophylactic antibiotic therapy consists of single dose of cefazolin preoperatively and two doses of cefazolin after surgery.

They were followed between 40 and 80 months.

## Surgical procedure

All patients are fully examined before surgery while standing and walking, looking for other joints involvement, spine deformity, gait disturbance and lateral thrust.

In preoperative standing three-joint view, mechanical axis of lower limb is measured, desired correction carefully planned and required wedge resection calculated.

Patient is placed supine on the operative table with operating knee flexed to 90° to minimize neurovascular injury.

An oblique incision from upper tibiofibular joint to tibial tubercle is made and extensor muscles elevated from lateral

proximal tibia. Two centimeter below the joint line, proximal osteotomy is made parallel to the table. Distal osteotomy is made in preoperatively calculated distance from the first cut pointing upward and medial to medial cortex.

Medial cortex should not be cut but weakened with multiple drilling. In order to destabilize the upper tibiofibular joint, complete capsulotomy of the joint from anterior capsule to posterior capsule is performed. After completing the osteotomy and achieving appropriate correction, rigid fixation with lateral buttress plate (locking plate or simple plate) is implemented.

And finally muscles, fascia and skin are sequentially repaired over a suction drain.

Postoperatively, partial weight bearing is advised immediately with accompanying quadriceps setting exercise, straight leg rising and ankle pump.

After 4–6 weeks, patients are recommended full weight bearing as the union is completed.

## Results

Mean duration of the surgical procedure was about 75 min (range 55–85 min).

Mean bleeding volume after the surgery was measured less than 300 ml (range 250–800 ml). In one patient during suction drain removal, a massive hemorrhage occurred (800 ml). He was transferred to operating room immediately and ruptured vein ligated.

Pain was controlled with IV acetaminophen and NSAID injection in most patients but few who required an additional single dose of narcotic injection.

Mean preoperation tibiofemoral angle was 12° varus (range 5°–20°).

Mean postoperation tibiofemoral angle was 5° valgus (range 0°–10°).

All patients achieved acceptable union in 6 weeks with no considerable limitation in knee ROM.

No avascular necrosis of proximal segment occurred.

One iatrogenic intra-articular fracture discovered in postoperative radiographies which ended in union.

One patient experienced sensory symptoms in peroneal innervated dermatomes without foot drop and motor symptoms which resolved in 8 weeks.

Six young males complained of knee hyperextension which resolved with physiotherapy in maximum of 6 months.

Symptomatic bilateral genu recurvatum occurred in one patient (two knees). Eventually dome osteotomy was necessary to correct the deformity.

Patients did not show any sign of deep or superficial infection.

Although varus instability could be detected frequently in operated knees, all resolved in 6 months and required no surgical intervention.

In one patient, tibial tubercle was inadvertently osteotomized. It was replaced in osteotomy site. And after closing the osteotomy, there was no need for additional fixation. Quadriceps force was normal after osteotomy union.

Five patients (nine knees) were middle-aged women. All women were overweight and obese. All suffered of painful varus knees with varus angle in upper limits of acceptable measures (mean  $17^\circ$  varus).

In one patient (46 years,  $20^\circ$  correction required and overweight), varus deformity recurred soon after the surgery in both knees. She developed sever varus knees with gait disorder and lateral thrust. Severity of symptoms necessitated deformity correction with bilateral dome osteotomy.

The 48-year-old female complicated with DVT in operated limb and admitted in CCU. She later refused the surgery on the other knee.

In another female, obese, 51 years old, varus deformity recurred in both knees. Right side was replaced with total knee arthroplasty within 2 years. Patellar tendon ruptured during exposure and repaired. She has full ROM and 5/5 quadriceps strength. She accepted remaining varus in the left knee and refused further surgery the left side. Preoperative measures were close to  $20^\circ$  of varus with lateral thrust (Fig. 1).

In another female, 45 years old, obese with sever genu varum ( $18^\circ$  of varus), deformity recurred within 2 years. Total knee replacement has been recommended.

One patient, 45 years old, 6 years postsurgery, satisfied with results despite partial recurrence. Preoperative measurements showed  $20^\circ$  of varus with lateral thrust.

The only young female, thin, 23 years old, is quite satisfied with results without recurrence (Fig. 2).

## Discussion

High tibial osteotomy is considered to be one of the most valuable procedures to relieve knee pain and prevent or slow down progression of degenerative changes in varus knee.

Literally, the position of mechanical axis determines load distribution across the knee [3–5].

In normally aligned knee, about 60% of load is transmitted through medial compartment [3].

Brouwer et al. [8] showed that varus malalignment was associated with twofold increase in development of osteoarthritis and also it increased progression of degenerative changes.

In varus knee, the load is predominantly exerted in the medial compartment [3, 4, 8].

It is been documented that redistribution of the load axis to the lateral compartment significantly reduces force on the medial part, minimizing medial compartment pain and degeneration [3–5].

Odenbring et al. in 1992 performed knee arthroscopy and obtained cartilage biopsy after high tibial osteotomy of 28 varus knee with degenerative changes in medial compartment. The authors showed fibrocartilage proliferation in fibrillated cartilage and vertical clefts. They also demonstrated chondrocyte regeneration and increased chondrocyte cellularity in hyaline cartilage [9].

Fujisawa et al. documented by arthroscopy that the ideal correction could be obtained when mechanical axis passes through a region 30% to 40% lateral to the midpoint of the

**Fig. 1** Fifty-one-year-old woman with preoperative measures close to  $20^\circ$  of varus, varus deformity recurred in both knees. Right side was replaced with total knee arthroplasty within 2 years. Patellar tendon ruptured during exposure and repaired. She has full ROM and 5/5 quadriceps strength





**Fig. 2** Twenty-three-year-old female, 2 years after closing wedge high tibial osteotomy with upper tibiofibular joint capsulotomy on the left knee. On the right side, correction had been achieved with upper tibiofibular joint osteotomy

knee. They recognized that in 2 years postideal realignment surgery, degenerated region was repaired with fibrous and membranous tissue [10].

Dugdale et al. calculated that the ideal correction is  $3^\circ$  to  $5^\circ$  valgus from mechanical axis which means that mechanical axis should pass through a point 62.5% between the medial and lateral compartment of the proximal tibia [4, 11].

Although Shaw and Moulton in a cadaveric study proposed that unloading of the medial compartment occurred only when the alignment is corrected to  $25^\circ$  of valgus, some authors criticized the results underscoring that dynamic situation in vivo with active muscles and viable soft tissue is entirely different with in vitro and cadaveric studies [12, 13].



**Fig. 3** Twenty-year-old male, 13 months after closing wedge high tibial osteotomy with upper tibiofibular joint capsulotomy

We aimed to achieve over-correction of  $3^\circ$  to  $5^\circ$  valgus.

Probable complications in closing wedge high tibial osteotomy include: peroneal nerve injury, nonunion, infection, iatrogenic tibial plateau fracture, avascular necrosis of proximal fragment and recurrence [6].

In this study, one patient experienced sensory peroneal nerve symptoms which resolved in 4 weeks spontaneously. This is less than 3% of operated knees.

Many of complications and undesirable outcomes of closing wedge high tibial osteotomy are due to fibular osteotomy. Peroneal palsy, fibular nonunion, upper tibiofibular joint instability and proximal tibiofibular joint synostosis are most reported complications. Peroneal nerve palsy, high percentage of which results in permanent deficit, is one of the most commonly reported complications [1, 7, 14–19].

Fibular osteotomy at the junction of the middle and inferior thirds is the most popular fibular osteotomy in order to avoid peroneal nerve injury.

Efe et al. [17] reported six cases of peroneal palsy which left permanent deficit in 199 cases after closing wedge high tibial osteotomy with fibular osteotomy at the junction of the middle and inferior thirds.

**Fig. 4** **a** 42-year-old man with prior closing wedge high tibial osteotomy and fibular osteotomy in the left knee in another center. **b** High tibial osteotomy without fibular osteotomy was performed on the left side with acceptable results at the last follow-up



Curley et al. [16] reported greater electrophysiological abnormalities when performing fibular osteotomy at the level of fibular head and neck. It seems that peroneal palsy might be one of the contributing factors to patient dissatisfaction of the operation [1, 8, 14–19].

In one study, Aydoğdu et al. [7] reported peroneal nerve injury in 27% of patients.

Low incident of peroneal injury in this study (3%) might be due to avoiding fibular osteotomy.

Knee hyperextension occurred in seven young males. Six patients had no complains after 6 months. In one patient, symptomatic genu recurvatum leading to gait abnormality required dome osteotomy in both knees.

This could be partly explained by decrease in posterior tibial slope that has been reported after closing wedge high tibial osteotomy.

Ducat et al. [20] in their multicenter study confirmed reports in the literature that closing wedge high tibial osteotomy decreased posterior tibial slope but they concluded that changes appeared to be very limited.

Nha et al. [21] in a meta-analysis confirmed decrease in posterior tibial slope after high tibial osteotomy but also suggested that it may have little effect on the biomechanics of the knee.

In our patient, genu recurvatum after surgery might be due to surgical pitfall, removing more wedges from anterior proximal tibia.

High rate of genu recurvatum might also be explained as resistance of intact fibula to closing the wedge acting as buttress.

All four females with partial or complete recurrence were obese, had varus deformity close to upper limits of study inclusion, and three of four revealed lateral thrust before surgery.

It has been suggested that ideal patient for osteotomy should have normal body weight. Patients more than 1.32 times normal body weight have poorer results after surgery [3].

Brouwer et al. [8] demonstrated that varus alignment was associated with twofold increased risk for knee osteoarthritis in overweight and obese individuals and not in normal weight participants.

Matthews et al. [22] ascertained that obesity and advanced age adversely influence the duration of satisfactory results.

Though obesity is considered to be associated with poorer outcomes, when other determining factors as required varus correction and lateral thrust are close to upper limit of inclusion criteria, the combination would result in worse outcomes.

## Conclusion

Closing wedge high tibial osteotomy with upper tibiofibular joint capsulotomy avoids complications associated with fibular osteotomy as pain and nonunion in fibular osteotomy site and peroneal nerve injury.

It is a useful surgery in young, normal weight patients with symptomatic genu varum (Figs. 3, 4a, b).

When selecting patients, it is vital to stick to inclusion criteria. When in two or more factors, the patient is close to upper limits of inclusion criteria, unsatisfactory outcomes might be expected.

Although upper tibiofibular joint capsulotomy is not considered a novel technique [4], this study tries to investigate pearls and pitfalls of the procedure.

Some shortcomings of the study are limited number of the patients and short-term follow-up.

## Compliance with ethical standards

**Conflict of interest** The author has no conflict of interest to disclose.

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