

## REVIEW

# High tibial osteotomy

## Osteotomia kości piszczelowej

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### Abstract

**Introduction.** We are currently experiencing revival of High Tibial Osteotomy (HTO) procedure. After having been forgotten in the 70s, when knee-joint arthroplasty gained popularity, it became more popular again at the beginning of this century and the procedure methodology has been refined. This procedure is widely performed to treat medial knee arthrosis. The main goals of HTO are pain relief, correction of lower limb axis and delaying the need of a knee replacement.

**Material and methods.** We performed 30 high tibial osteotomies between March 2013 and March 2017 (11:19 male:female). The patients completed 3 questionnaires – Knee Injury and Osteoarthritis Outcome Score, International Knee Documentation Committee (IKDC) Subjective Knee Evaluation and Knee Society Score – just before osteotomy and after mean follow up of 44.4 months.

**Results.** After comparing the results we achieved significant improvement in every questionnaire. The mean result in KOOS survey increased from 43.6% to 89.2% and IKDC from 21.6 to 69.5 (max 87 points). We also observed improvement in both parts of KSS questionnaire. In the first one, which measures the range of motion and varus of knee joint from 41% to 94% and in the second part, which assess functionality of the knee from 44,2% to 90,8%. One of IKDC score questions enables patients to rate the function of their knees on a scale from 0 to 10 prior to osteotomy and currently. The improvement was remarkable-the mean result before was 2.6 and now 8.6.

**Conclusions.** In our study we confirmed HTO as appropriate way of treatment for active patients under 65 years old with medial knee OA and varus malalignment. HTO was a proper procedure to correct knee malalignment, relief pain, improve patients' functionality and their life-quality in a 44.4 months observation. Therefore we strongly advocate High Tibial Osteotomy in that group of patients.

**Key words:** high tibial osteotomy, medial knee osteoarthritis, varus knee deformity

### Streszczenie

**Wstęp.** Osteotomia kości piszczelowej jest zabiegiem przeżywającym aktualnie swój renesans. Zapomniana w latach 70-tych, gdy na popularności zyskała alloplastyka stawu kolanowego, popularność odzyskała na początku XXI w. po wprowadzeniu licznych innowacji. Obecnie zabieg ten jest stosowany w leczeniu średniozaawansowanych zmian zwyrodnieniowych w przedziale przyśrodkowym kolana. Głównymi celami osteotomii kości piszczelowej są: uśmierzanie bólu, poprawa osi mechanicznej kończyny i odroczenie w czasie konieczności przeprowadzenia alloplastyki stawu kolanowego.

**Materiał i metody.** Wykonaliśmy 30 osteotomii kości piszczelowych pomiędzy marcem 2013 r. a marcem 2017 r. (11:19 mężczyźni: kobiety). Pacjenci wypełnili 3 kwestionariusze- Knee Injury and Osteoarthritis Outcome Score, International Knee Documentation Committee (IKDC) Subjective Knee Evaluation and Knee Society Score – przed zabiegiem i średnio 44,4 miesiąca po nim.

**Wyniki.** Po porównaniu wyników uzyskaliśmy znaczną poprawę w każdym kwestionariuszu. Średni wynik ankiety KOOS wzrósł z 43,6% do 89,2%, natomiast w przypadku kwestionariusza IKDC pacjenci otrzymywali średnio 21,6 pkt przed osteotomią a po niej -69,5ptk (maksymalnie 87 pkt). Poprawa dotyczyła obydwu części kwestionariusza KSS. W pierwszej z nich, która oceniała m.in. zakres ruchu i zaawansowanie szpotawości kolana pacjenci uzyskiwali średnio 41% przed i 94% po wykonaniu osteotomii, w drugiej części oceniającej funkcjonalność pacjenta zanotowaliśmy wzrost z 44,2% do 90,8%. Największą poprawę zaobserwowaliśmy w jednym z pytań kwestionariusza IKDC, które określało funkcjonalność stawu kolanowego przed i po wykonaniu zabiegu w skali od 0 (bardzo zła funkcjonalność) do 10 (brak problemów z kolaniem). Przed osteotomią średni wynik wynosił 2,6, obecnie wynosi on 8,6.

**Wnioski.** Nasze badanie potwierdza, że osteotomia kości piszczelowej jest odpowiednim sposobem leczenia aktywnych pacjentów poniżej 65 roku życia, z chorobą zwyrodnieniową przyśrodkowej strony stawu kolanowego oraz jego szpotawością. W obserwacji 44,4-miesięcznej wykazaliśmy, że procedura ta była skuteczna w korekcji koślawości kończyny, przynosiła ulgę w bólu, poprawiała funkcjonowanie oraz jakość życia. Z tego powodu polecamy osteotomie kości piszczelowej jako metodę leczenia dla tej grupy pacjentów.

**Słowa kluczowe:** osteotomia kości piszczelowej, choroba zwyrodnieniowa stawu kolanowego, szpotawość stawu kolanowego

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Received: **3.01.2019**  
Accepted: **02.08.2019**  
Published: **7.11.2019**



## Introduction

Osteoarthritis (OA) is most common cause of knee pain. [1,2,3] Most effective way of treatment is total knee replacement (TKA) with satisfaction among older patients as high as 0 points on a 0 to 100 VAS scale (100 = best score). [4] However, TKA is not optimal for active patients under 65 years old with early-stage unicompartmental knee osteoarthritis caused by varus- or valgus malalignment, especially if they not only want a pain relief but also want to return to sport at an equal level. In that specific group of patients well accepted procedures are osteotomies around the knee. [5,6,7] One of them is High Tibial Osteotomy (HTO). Its goal is to mitigate pain, improve functionality and delay the need of the knee replacement. According to latest report patients with massive unicompartmental OA required conversion to total knee arthroplasty at 7 years after HTO. [8] Ensured proper patient selection, accurate preoperative planning, modern surgical fixation techniques and rapid rehabilitation, osteotomy around the knee is now an effective knee disorders biological treatment. In cases of extremity malalignment this technique can be also an adjuvant treatment after intraarticular procedures, such as: osteochondral autograft transfer system; autogenous chondrocyte transplantation; matrix-associated chondrocyte implantation; collagen meniscus implant. It can be also applied as additional treatment of knee instability with varus deformity.

### Purpose of the study:

1. The first purpose of the study was to compare pre- and post-operative extremity alignment and range of knee motion.
2. The second purpose of the study was to assess pain relief and life-quality improvement after High Tibial Osteotomy.

## Materials and methods

We treated 32 patients (36 knees) between March 2013 and March 2017 with classical biplanar open-wedge HTO. Carbon fibre reinforced PowerPEEK plate and titanium screws were applied. All operations were performed by the same orthopaedic surgeon.

The inclusion criteria for the procedure were:

1. Unicompartmental medial knee osteoarthritis.
2. Varus deformity of lower extremity.
3. Patients under 65 years old.

Patients completed 3 questionnaires, before and after osteotomy with the mean follow up of 44,4 (SD± 13,38) months: – Knee Injury and Osteoarthritis Outcome Score (KOOS). – International Knee Documentation Committee (IKDC) Subjective Knee Evaluation.

– Knee Society Score (KSS).

We examined patients before and after osteotomy with the mean follow up of 44.4 (SD ±13.38) months, according to the first part of Knee Society Score ( Flexion Contracture, Extension Lag, Varus Alignment, Anterior-posterior and Medial stability). Moreover, we asked patients to answer the questions contained in the second part of KSS score, IKDC score and KOOS score. The last one consisted of 5 subtotal parts- Symptoms + Stiffness, Pain, Function and daily living, Function sports and recreational activities, Quality of life.

Mean age of patient during the osteotomy was 57.8 (SD±11.78) years. Data of our group is shown in Table 1. Arthroscopies were performed prior to 26 out of 30 osteotomies with a mean time between knee arthroscopy and osteotomy 22.6 months (SD ±34.12). All of them were performed by the same surgeon.

Microfractures or collagen augmentation were performed during arthroscopies. These procedures were shown to accelerate chondral regeneration after HTO [9,10].

Statistical analysis was performed. The test used were:

Table 1. Data of our group.

Mean age	57.8 (SD±11.78)
Mean follow up (months)	44.4(SD± 13.38)
Male:Female	11:19
Side	10x Left 12x Right 4x Bilateral
Mean time between knee arthroscopy and osteotomy	22,6 months (SD ±34.12)

Shapiro-Wilk test of normality, Levene's test of homoscedasticity, Wilcoxon signed-rank test, paired samples t-test. Significant p value was set under 0.05.

## Results

We obtained results from 26/32 patients who were scheduled to HTO treatment. Unfortunately we lost contact with 6 of our convalescents (each of them underwent unilateral HTO).

### KSS

Mean result of preoperative KSS Knee Score examination was 41/100. After surgery we received significant improvement with mean postoperative result 94/100 (p<0,00001). We investigated all patients before and after osteotomy with the mean follow up of 44,4 months. Preoperative mean varus deformity was 12,96° (11°-15°), as presented in Table 2. After HTO all patients got proper alignment according to KSS questionnaire (5°-10°).



Table 2. Varus deformity before surgery.

Varus deformity before HTO	11°	12°	13°	14°	15°
Knees	4	10	6	3	7

In 26 out of 30 knees we got full range of motion – 121°-125°. In other 4 possibilities of flexion got slightly reduced – 116°-120°. Patients noticed improvement in the distance that they could walk and none of them needed aids to walk anymore.

We noticed significant enhancement in second part of that questionnaire too- from mean 44.2/100 to 90.8/100 points (p<0.00001).

**IKDC**

Maximum postoperative score in the IKDC Subjective Knee Evaluation was 87 points. Mean result before HTO was 21.6 points and after 69.7 (p<0.000000000000001). On a scale of 0 to 10 with 0 being “never pain” and “no pain” and 10 being “always pain” and “worst pain” we noticed huge amelioration. According to that scale pain frequency changed from 7.6 to 2.2 and intensity from 8.1 to 2.8 (p<0.00001). Most interesting is the last question of that score, assessing ability to perform daily activities. As we can see, patients judge their function in this area on 2.7 before surgery and on 8.6 afterwards (Fig. 1).

**Results**

*How would you rate the function of your knee on a scale of 0 to 10 with 10 being normal, excellent function and 0 being the inability to perform any of your usual daily activities which may include sports?*

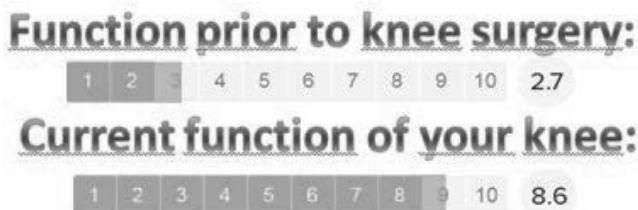


Fig. 1. One of IKDC questionnaire question.

**KOOS**

We observed significant improvement in every subtotal part of KOOS score (Tab. 3). Total KOOS score preoperatively was 43.6% and postoperatively 89.2% (p<0.0000000001). Best proof of patients satisfaction is last subtotal part of KOOS score – quality of life. We noticed 58.6% advancement (from 27.2% to 85.9%) after HTO (p<0.00001).

Table 3. Subtotal parts of KOOS score.

Subtotal part of KOOS score	Before Osteotomy	After Osteotomy
Symptoms + Stiffness	50,2%	89,5% (p<0,00001)
Pain	40,1%	92,1% (p<0,00001)
Function, daily living	53,4%	93,6% (p<0,00001)
Function, sports and recreational activities	20,6%	71,9% (p<0,00001)
Quality of life	27,2%	85,9 (p<0,00001)

Our worst results concerned kneeling, but there was still improvement postoperatively. Only 27% have no problems or mild problem with that activity (Fig. 2).



Fig. 2. Problems with kneeling.

**Discussion**

High Tibial Osteotomy is old and well-known way of treatment of patients with medial knee osteoarthritis. One of the first who described outcome of HTO was J. P. JACKSON in 1958. [11]. In 70’s osteotomies became less frequently performed due to spreading TKA acceptance. However, in XXI century after some changes some of them like HTO became more popular. [12,13] Patients selection and appropriate pre-operative planning is crucial for success in High Tibial Osteotomy procedure.

**Patients selection**

The factors to concern in decision making are age, level of activity and extremity alignment. To our study we enrolled active patients under 65 years old with unicompartmental medial OA and varus deformity of lower extremity. In patients under 65 years old, age did not influence HTO outcome in our study, which is consistent with the literature. In the paper of Kohn et al. there was no reported difference in outcome when comparing patients with mean age 57 and those with mean age of 42. [14] The same as in our group, patients classified to HTO



are usually active so they wish to return to sport at an equal or greater level. In a literature 87 % of patients came back to sport activity and 78% on a same intensity but rehabilitation and motivation of a patient were crucial. [15,16] Our patients did not regularly participate in strenuous sports before HTO but all of them returned to less aggravating activities that they performed before surgery like cycling, swimming or volleyball.

### Outcomes measurement

The first part of KSS score proved High Tibial Osteotomy to be a valid tool in correcting of malalignment. Regarding knee pain relief and patients satisfaction we used the second part of KSS score and also KOOS and IKDC scores. Huge difference in all three total scores values and every subtotal part of KOOS score is a real proof of enhancement in patients satisfaction after High Tibial Osteotomy. The action that was the most problematic for our patients was kneeling. Interestingly, the main source of problem with kneeling in most patients was not the pain, but the discomfort caused by the presence of plate in tibia. However, despite this discomfort they were reluctant to undergo a revision surgery in order to remove the plate.

### Conclusions

In our study we confirmed HTO as appropriate way of treatment for active patients under 65 years old with medial knee OA and varus malalignment. HTO was a proper procedure to correct knee malalignment, relief pain, improve patients' functionality and their life-quality in a 44.4 months observation. Therefore we strongly advocate High Tibial Osteotomy in that group of patients.

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