

# COST-UTILITY ANALYSIS OF TORIC AND MONOFOCAL INTRAOULAR LENSES IN CATARACT SURGERY FOR ASTIGMATIC PATIENTS IN THE CZECH REPUBLIC

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## Background

The crystalline lens becomes opaque with aging, resulting in a deterioration of visual functions. Cataract surgery is the only treatment option, where the clouded crystalline lens is replaced with an artificial lens. Traditional monofocal intraocular lenses (IOLs) correct only one of the refractive error - they usually restore distance vision acuity but are unable to correct corneal astigmatism, unlike toric intraocular lenses. Additionally, toric IOLs have the ability to improve patients' freedom on spectacles.

## Objectives

The objective of this study was to evaluate the cost-utility of toric IOL(s) compared with monofocal IOL(s) implantation during cataract surgery for corneal astigmatism in the Czech Republic.

This analysis is one of the first evaluations of medical devices in the Czech Republic, as medical devices are currently not standardly subject to health economic evaluation here.

## Methods

A lifetime Markov cohort model with a one-month cycle length was developed to project outcomes (Quality-Adjusted Life-Years, QALYs); spectacles use) and costs for astigmatic patients undergoing unilateral or bilateral cataract surgery from the health care payer's perspective, which was either expanded to include the patient's perspective or not.

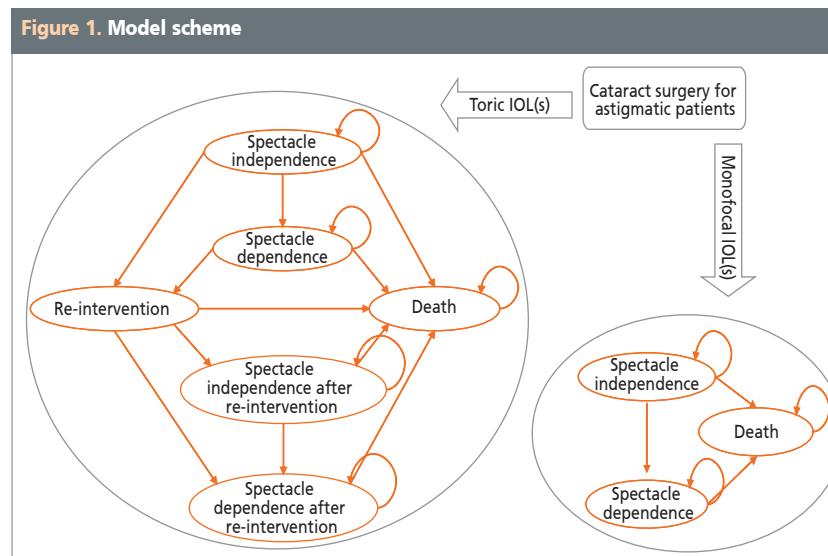
Model health states are defined by the need for spectacles for sharp vision after cataract surgery, the occurrence of possible (post)operative complications, and death. **Figure 1** illustrates the model scheme.

The probability of spectacle (in)dependence associated with postoperative visual acuity and/or residual astigmatism, as well as toric IOL repositioning due to IOL rotation requiring re-intervention, was sourced from Holland et al.<sup>1,2</sup> for unilateral cataract surgery and from Lane et al.<sup>2,3</sup> for bilateral cataract surgery (**Table 1**). The types of spectacles prescribed for those requiring them were derived from Laurendeau C et al<sup>4</sup> (**Table 2**). Other benefits and harms associated with the implantation of toric and monofocal IOL(s) during cataract surgery are similar according to Kessel et al.<sup>5</sup>

The mortality rate was sourced from Czech mortality tables<sup>6</sup> and it was assumed that cataracts do not affect common mortality rate.

Spectacle replacement (every 3 years) was based on the statement of KOLs.<sup>7</sup>

Utilities and relevant disutilities were taken from published literature (Sullivan et al.<sup>8</sup> & Luo et al.<sup>9</sup>, **Table 3**) and combined using an additive approach. It is assumed that the quality of life for patients after cataract surgery is equivalent to that of the general population due to the restoration of visual acuity; however, spectacle dependence and/or (post)operative complications can impair quality of life.



Costs for cataract surgery, including lens(es) implantation (**Table 4**), management of complications including IOL repositioning (**Table 5**), spectacles and their maintenance (**Table 6**), and associated ophthalmologic care (**Table 7**), were based on KOLs' statements<sup>7</sup> and reimbursement lists<sup>10,11,12</sup>.

Costs and outcomes were discounted at 3% annually.

Deterministic sensitivity analysis (DSA) – scenario analysis (SA) were conducted.

**Table 1. Spectacles dependence<sup>1,2,3</sup>**

	Spectacles dependence after 6 months	
	Toric IOL	Monofocal IOL
Unilateral surgery	39.1% <sup>1,2</sup>	63.6% <sup>1,2</sup>
Bilateral surgery	2.6% <sup>2,3</sup>	48.9% <sup>2,3</sup>

**Table 2. Type of spectacles<sup>4</sup>**

	Bilateral/unilateral surgery	
	Toric IOL	Monofocal IOL
Reading	74.3%/60.9%*	30.0%/36.4%*
Distance	0.0%/0.0%*	0.0%/0.0%*
Reading & distance	0.0%/0.0%*	5.0%/4.5%*
Bifocal	17.1%/26.0%*	50.0%/45.4%*
Other (multifocal)	8.6%/13.1%*	15.0%/13.6%*

\*assumption – utilization of particular type of spectacles based on distance spectacle independence after unilateral operation and distribution of types of spectacles after bilateral operation

**Table 3. Utility of general population<sup>8</sup> and disutility of spectacles<sup>9</sup> wearing<sup>8</sup> and toric IOL reposition<sup>9</sup>**

	(Dis)utility		
	age 60–69	age 70–79	age 80–89 & 90+*
General population	0.774 <sup>8</sup>	0.723 <sup>8</sup>	0.657 <sup>8</sup>
Toric IOL reposition ~ cataract**		-0.0271 <sup>8</sup>	
Spectacle dependence		-0.0200 <sup>9</sup>	

\*assumption – utility of older people is not higher than younger people

\*\*assumption – same as disutility of cataract based on not improvement of visual acuity associated with cataract due to reposition of toric IOL following the operation

**Table 4. Costs on cataract surgery including monofocal IOL(s) implantation<sup>7,10,11</sup>**

	Total costs per surgery (€), unilateral surgery			Total costs per surgery (€), bilateral surgery		
	Payer	Patient	Sum	Payer	Patient	Sum
Cataract surgery	692	44	736	1 320	87	1 408
monofocal IOL(s)	726	431	1 157	1 387	862	2 249
toric IOL(s)						

**Table 5. Costs on management of complications<sup>7,10,11</sup>**

	Total costs per intervention (€)		
	Payer	Patient	Sum
IOL repositioning	255	0	255

**Table 6. Costs on spectacles and its maintenance<sup>7,12,Table 2</sup>**

	Total costs per spectacle (€), unilateral surgery			Total costs per spectacle (€), bilateral surgery		
	Payer	Patient	Sum	Payer	Patient	Sum
Spectacles after implantation	0	189	189	0	195	195
monofocal IOL(s)	0	173	173	0	159	159
toric IOL(s)						

**Table 7. Costs on regular ophthalmologic care<sup>7,10,11</sup>**

	Total costs per year (€)		
	Payer	Patient	Sum
Regular ophthalmologic care	35	29	63

**Table 8. CUA results for bilateral cataract surgery**

	Bilateral surgery		
	Toric IOLs	Monofocal IOLs	Difference
Total costs (€), health care payer's perspective	1 496	1 661	-165
- cataract surgery including IOLs	1 387	1 320	66
- re-intervention due to IOL' repositioning	1	0	1
- spectacles	0	0	0
- regular ophthalmologic care	108	340	-232
Total costs (€), health care payer's & patients' perspectives	2 642	2 784	-142
- cataract surgery including IOLs	2 249	1 408	841
- re-intervention due to IOL' repositioning	1	0	1
- spectacles	196	757	-561
- regular ophthalmologic care	196	619	-423
QALY	7,2991	7,1660	0,1332
- utility of common population	7,3610	7,3610	0,0000
- disutility of re-intervention	-0,00001	0,00000	-0,00001
- disutility of spectacles	-0,0619	-0,1950	0,1332
ICER (€/QALY), health care payer's perspective		Toric IOLs - dominant	
ICER (€/QALY), health care payer's & patients' perspectives		Toric IOLs - dominant	

## Results

Astigmatic patients require up to 2.7 fewer spectacles over their remaining lifetime after cataract surgery with the implantation of toric IOL(s) compared to monofocal IOL(s).

Unilateral and bilateral toric IOL(s) implantation provides an additional 0.009 QALYs (7.171 vs. 7.161) and 0.113 QALYs (7.299 vs. 7.166), respectively, compared to monofocal IOL(s) implantation regardless of the perspective used, primarily due to increased spectacle independence, which enhances patients' quality of life.

Bilateral implantation of toric IOLs compared to monofocal IOLs results in total incremental cost savings of €165 from the health care payer's perspective and only €142 when considering both perspectives, making it the dominant strategy (**Table 8**).

Unilateral implantation of the compared lenses yields an incremental cost-effectiveness ratio of €1,977/QALY gained from the health care payer's perspective and €31,111/QALY gained when both perspectives are combined, with additional costs of €19 and €294, respectively (**Table 9**).

SA confirmed the robustness of the cost-effectiveness results for toric lenses.

**References**  
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