



## ■ KNEE

# Reliability of the Oswestry-Bristol Classification for trochlear dysplasia

## EXPANDED CHARACTERISTICS

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### Aims

The Oswestry-Bristol Classification (OBC) was recently described as an MRI-based classification tool for the femoral trochlear. The authors demonstrated better inter- and intraobserver agreement compared to the Dejour classification. As the OBC could potentially provide a very useful MRI-based grading system for trochlear dysplasia, it was the aim to determine the inter- and intraobserver reliability of the classification system from the perspective of the non-founder.

### Methods

Two orthopaedic surgeons independently assessed 50 MRI scans for trochlear dysplasia and classified each according to the OBC. Both observers repeated the assessments after six weeks. The inter- and intraobserver agreement was determined using Cohen's kappa statistic and S-statistic nominal and linear weights.

### Results

The OBC with grading into four different trochlear forms showed excellent inter- and intraobserver agreement with a mean kappa of 0.78.

### Conclusion

The OBC is a simple MRI-based classification system with high inter- and intraobserver reliability. It could present a useful tool for grading the severity of trochlear dysplasia in daily practice.

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### Introduction

In patients with patellofemoral instability, dysplasia of the femoral trochlea is common, as trochlear dysplasia is the most important risk factor for recurrent patella dislocation.<sup>1-4</sup> Therefore, besides analyzing all other passive and active stabilizers of the patellofemoral joint, it is important to assess the form of the femoral trochlea during the individual workup of the pathomorphological causes of patella instability.

For grading of trochlear dysplasia, Dejour et al<sup>5</sup> introduced a three-grade classification system in 1990. It was subsequently modified in 1998 to four grades in order to improve the inter- and intraobserver agreement.<sup>6,7</sup> Still, the Dejour classification system, which was based on radiographs and CT, demonstrated

an inconsistent inter- and intraobserver agreement throughout the literature over the years, especially when MRI was used.<sup>8-13</sup>

In 2020, Sharma et al<sup>14</sup> published a new classification system for trochlear dysplasia: the Oswestry-Bristol Classification (OBC). This MRI-based, four-grade system is depicted in figure 1.

The OBC could potentially provide a very useful grading system for trochlear dysplasia. It was the purpose of this study to firstly validate the inter- and intraobserver agreement of the classification system by non-founding authors.

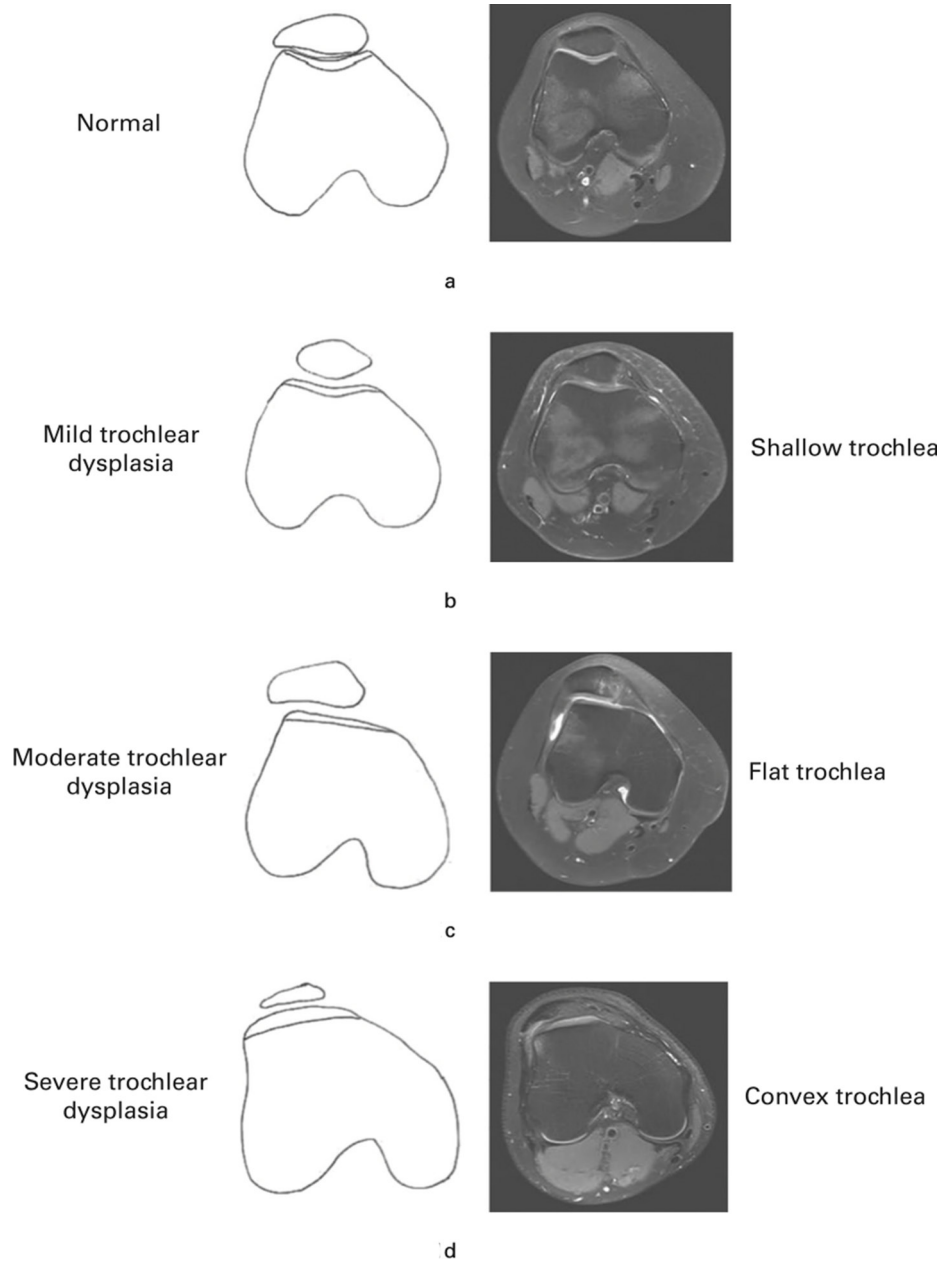
### Methods

From our database, we retrospectively identified 50 knee MRI scans, which were performed

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**Fig. 1**

The Oswestry-Bristol Classification (OBC). Drawings and MRI (reprinted<sup>14</sup>).

in different patients who presented due to patellofemoral symptoms of pain or instability. These patients did not have any history of knee surgery altering the form of the femoral trochlea prior to MRI.

Two orthopaedic surgeons (Orthopaedic Sports Medicine Fellow (SSA)/Fellowship-trained Senior Consultant (CK)) independently graded the axial T2-weighted MRI slices according to OBC, in normal trochlea, mild trochlear dysplasia (shallow trochlea), moderate (flat trochlea), or severe (convex trochlea) trochlear dysplasia. Both observers repeated the assessments after six weeks. For

the second phase, the order of MRI scans was randomized to eliminate any bias from the first reading.

We determined the interobserver agreement using Cohen's kappa statistic.<sup>15</sup> A kappa value greater than 0.75 represents excellent agreement beyond chance, whereas values below 0.40 represent poor agreement.<sup>16</sup> We also determined the S-statistic to verify the kappa value.<sup>17</sup>

For determining the intraobserver agreement, we calculated the mean kappa of both observers.<sup>18</sup> All statistical analyses were performed using the software R, Vienna, Austria.

**Table I.** Interobserver agreement, kappa-statistic, and S-statistic values for the first and second round of observations.

Round of assessment	Observed agreement	Expected agreement	Kappa (95% CI)	S-statistic (nominal) (95% CI)	S-statistic (linear weights) (95% CI)
1	90.0%	86.96%	0.69	1.480	1.960
2	96.0%	89.04%	0.77	1.645	1.645

CI, confidence interval.

**Table II.** Expanded characteristics of the MRI-based Oswestry-Bristol Classification (OBC) for trochlear dysplasia.

OBC Type	Form of trochlea	Severity of trochlear dysplasia	Cartilagenous sulcus angle	Lateral Trochlear Inclination (LTI)	Indication for Trochleoplasty?
0	Normal	No trochlear dysplasia	Normal (< 145°)	≥ 11°	No
1	Shallow	Mild	Elevated (≥ 145°)	< 11°	No
2	Flat	Moderate	180°	0°	Seldom needed
3	Convex	Severe	> 180°	< 0°	Consider trochleoplasty

MRI, Magnetic Resonance Imaging.

## Results

According to the ratings of both orthopaedic surgeons using the OBC, 6% (n = 3) of all trochleae were classified as normal, 56% (n = 28) as mild dysplastic, 22% (n = 11) as moderate dysplastic, and 16% (n = 8) as severe dysplastic.

We determined the interobserver agreement, kappa-statistic and S-statistic values separately for each set of observations (Table I). In the first round of observations, the agreement was 90% and in the second round it was 96%. Also, the intraobserver agreement was excellent with a kappa-value of 77% for the first observer and a kappa-value of 79% for the second observer.

## Discussion

This study represents the first inter- and intraobserver agreement validation of the MRI based OBC for trochlear dysplasia by non-founders. We demonstrated excellent intra- and interobserver reliability of the classification tool.

In specialized orthopaedic departments, patients with patellofemoral instability symptoms present regularly. Besides history and thorough clinical evaluation, radiograph examination and MRI of the knee represent part of the standard workup.

The originally CT-based Dejour Classification for trochlear dysplasia is known to be the standard grading system for the form of the trochlear. This classification system showed inconsistent intra- and interobserver reliability in several studies, whereas the first classification of Henri Dejour, published in 1990 (three grades), demonstrated lower agreements than the second classification by David Dejour, published in 1998 (four grades).<sup>8-13</sup> An advantage of the OBC over the Dejour classification besides its simplicity is that it can reliably be used with standard T2-weighted axial MRI slides of the knee. Furthermore, it simplifies the classification to relevant categories.

In Table II, we summarize the OBC and add aspects, which we consider as important. This overview should facilitate future usage of the classification system as much as possible.

We find differentiation between normal (Type 0) and shallow (Type 1) trochleae the single most difficult aspect in the application of the OBC. Potentially, the sulcus angle might be helpful to differentiate between a normal form of the trochlea and a mild trochlear dysplasia. But the normal sulcus angle differs widely in healthy knees.<sup>19</sup> The so-called “Oblique Trochlear View (OTV)” means special and modified axial MRI slides of the knee for evaluation of the femoral trochlea. The OTV displays a more uniform sulcus angle and depth along the trochlea.<sup>20</sup> But this requires a modified MRI or software, which is not available on regular daily basis as patients normally present with a standard MRI of their symptomatic knee. Additionally, there are gender-related differences in the sulcus angle: females have a significantly greater sulcus angle than males.<sup>21</sup> Thus, the sulcus angle is not a perfect differentiator between a normal (Type 0) and shallow (Type 1) trochlea, although a recently published review and meta-analysis found a cartilagenous sulcus angle of at least 143° in patients with patellofemoral instability.<sup>22</sup> Nevertheless, deciding if a certain individual trochlear form is normal (Type 0) or mildly dysplastic (Type 1) remains partially subjective. Differentiation between greater degrees of trochlea dysplasia according to the OBC seems to be more reproducible.

Carrillon et al<sup>23</sup> described the Lateral Trochlear Inclination (LTI). This is an angle measured on axial MRI between the posterior condylar line and the lateral trochlear facet. The authors demonstrated an LTI of 11° or higher in stable patellofemoral joints and an LTI < 11° in patellofemoral instability.

As there are many aspects involved in patellofemoral instability, a treatment algorithm cannot be developed from a classification for trochlear dysplasia alone. But we like to mention that patella height correlates with trochlear dysplasia: a higher positioned patella is associated with a more dysplastic trochlea.<sup>24</sup> We hypothesize that a severely dysplastic trochlea is responsible for a patella alta and leads to shortening of the quadriceps muscle. This is important for planning of surgical treatment, as a distalization of the

tibial tuberosity alone seems to be unsuccessful in severe trochlear dysplasia with a convex trochlea form.

In conclusion, the Oswestry-Bristol Classification (OBC) as an MRI based grading system for trochlear dysplasia showed excellent intra- and interobserver agreement. Therefore and because of its simplicity in usage, the OBC seems to be a very good system for classifying trochlear dysplasia in daily practice.



### Take home message

- The Oswestry-Bristol Classification (OBC) is an easy to use grading system for trochlear dysplasia with excellent inter- and intraobserver reliability.

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### Author contributions:

- C. Konrads: Planned the study, Collected and analyzed the data, Wrote the manuscript.
- C. Gonser: Carried out the statistic work-up, Revised and approved the manuscript.
- S. S. Ahmad: Collected the data, Revised and approved the manuscript.

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