Recommendations for the follow-up of children with leg length discrepancy: expert consensus

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ABSTRACT

Leg length discrepancy is when the length of one leg is different from the other, and is a common reason for consultation at the pediatrician's and pediatric orthopedist's office. The ***objective*** of this study was to develop recommendations for the follow-up, pre-surgical planning, and treatment of children with leg length discrepancy based on expert consensus.

Material and methods. The Delphi method was used. A coordinating group selected a panel of experts, designed and analyzed each of the rounds of consultations. Semistructured questionnaires were sent by personalized e-mail. Agreement among experts ≥ 80 % was established as the criterion for consensus. At each round of consultation, non-consensual aspects were reformulated and new aspects suggested in the previous round were included. A measure of stability to conclude the consultation was determined when more than 70 % of experts sustained their opinion in successive rounds.

Results. Eight experts in orthopedics and six experts in imaging studies participated. After three rounds of consultations, consensus was reached in terms of 39 recommendations for follow-up, pre-surgical planning, and treatment. These were reorganized into 32 final recommendations.

Conclusions. These are the first recommendations for the follow-up of children with leg length discrepancy agreed by expert consensus.

Key words: *discrepancy, lower limbs, consensus, clinical practice guideline.*

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INTRODUCTION

Leg length discrepancy or asymmetry is when the length and/or circumference of one leg is different from the other, and is a common reason for consultation at the pediatrician's and pediatric orthopedist's office. Its prevalence is unknown and, to date, there is no cutoff point as of which discrepancy would be considered pathological; however, prevalence studies conducted in different populations have shown differences of up to 1.5 cm in 30 % of boys during military training without clinical significance.[1-3]

Discrepancies are classified into a) functional, resulting from joint or muscle contractures or leg axis misalignment or b) structural, caused by inequalities in bone length. The latter may be congenital (isolated lateral hypertrophy, congenital hip dislocation, hemimelia) or acquired (post-fracture, neurological, infectious, neoplastic).[4,5]

The objective of treatment is to match the current and the adult length of legs to prevent complications, such as compensatory mechanisms, low-back pain, functional scoliosis, hip osteoarthritis or body image alteration, especially, during adolescence.[4,6] Treatment may be medical, with lifts for the short leg, or surgical, lengthening the short leg, shortening the long leg, or a combination of both.[4,7-10]

Surgical planning requires estimating adult-age discrepancy and the optimal timing for surgery. There

are different prediction methods, including the Anderson, Moseley, and Multiplier methods.[11-13]

Although there is ample bibliography on prediction methods and surgical techniques, no follow-up recommendations have been established for this group of patients. Follow-up usually depends on the facility's or orthopedist's experience.

Therefore, the objective of this study was to develop recommendations for the follow-up, pre-surgical planning, and treatment of children with leg length discrepancy based on expert consensus using the Delphi method.

MATERIAL AND METHODS

Recommendations were developed based on the Delphi method, a group communication process that allows a group of individuals, as a whole, to deal with a complex problem. It objective is to establish agreement among experts regarding the proposed problem.[14,15]

A coordinating group (SC, RRM, VF, RG, DF) designed the list of aspects to be agreed on, selected the expert panel, and analyzed each of the rounds of consultations.

The aspects submitted for consensus were follow-up (clinical and radiological), pre-surgical planning, and treatment. A systematic review was conducted by using "discrepancy," "asymmetry," and "leg length" in Pubmed and Lilacs as search engines up to December 2016.

Seventeen experts were invited to participate in the study (10 experts in orthopedics and 7 in imaging studies). The latter only participated in the consensus on "X-ray request and measurement" for pre-surgical planning. The only expert selection criterion was the level of experience (≥ 10 years) in the follow-up of children with discrepancies. The seven experts in imaging studies and seven of the orthopedists were Argentine; two orthopedists were Chilean and one, Paraguayan. Expert distribution was balanced in terms of place of work (public versus private sector).

Agreement among experts ≥ 80 % was established as the criterion for consensus. Twenty-four percent of opposite questions were included to analyze answer reliability. To conclude the Delphi process, when > 70 % of experts not changing their answers from the previous round was considered a measure of stability.

The Delphi process consisted in a series of questionnaire rounds sent by personalized e-mail between December 2016 and November 2017. The initial round consisted in a series of 45 statements with a five-point Likert scale (from "strongly disagree" to "strongly agree"), and eight open-ended questions.

The subsequent rounds consisted in reformulating aspects for which no consensus had been reached based on the experts' claims, introducing new aspects for consensus suggested in the previous round, and asking again experts who had not agreed, together with their claims.

Finally, the list of agreed recommendations was reviewed by each expert and reorganized, and the final document was presented.

RESULTS

Fourteen experts participated in the consensus; eight in orthopedics and six in imaging studies; they had a median 20 years of experience (r: 11-43). After three rounds, the consultation process shown in *Figure 1* was concluded.

After round 1, consensus was reached in 22 out of 45 statements. Experts recommended to determine the etiology of discrepancies and their evolutionary pattern; group them into congenital and acquired; request a baseline X-ray, regardless of the child's age; predict, at least two times, the magnitude of the adult-age discrepancy and the timing for epiphysiodesis; assess the height of the lift yearly and every 6 months during puberty; and consider the estimated final height in the surgical treatment choice. Consensus was reached in five out of 14 statements common to both panels: to request a telemetry of the lower limbs instead of a scanogram and to indicate, in the X-ray request, the height of the lift and anatomical landmarks to measure each of the lower limb segments described in *Table 1*.

After round 2, consensus was reached in 10 out of 23 statements. Four of the experts who had been indifferent and two of the three experts who had disagreed with the statements agreed on in the previous round –marked with an * in *Table 2*– changed their opinion, thus improving the percentage of agreement. The new consensual aspects were the frequency of X-ray controls, the performance of an X-ray in recumbent position up to 2 or 4 years old and then with the patient standing and wearing a lift, indicate the lift height by clinical and radiological measurement and then perform an epiphysiodesis of the long leg for predicted adult discrepancy > 2 cm, and the inclusion of the treating pediatrician and/or pediatric endocrinologist for the assessment of pubertal development.

FIGURE 1. *Expert consensus. Consultation process flowchart*

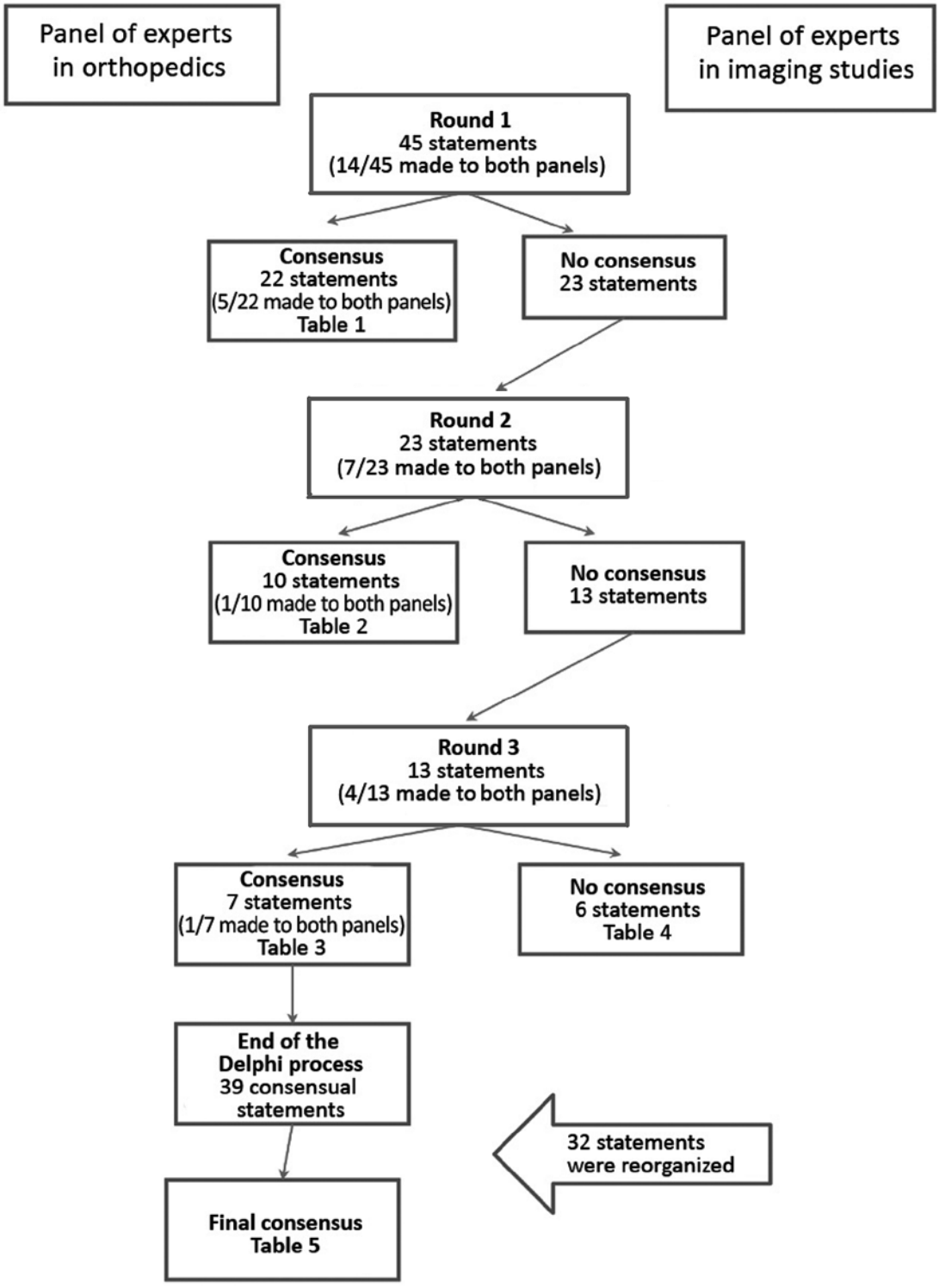

Table 3 shows a summary of the recommendations agreed on in round 3 (7/13). It was agreed to reduce the frequency of X-ray controls in children with a current and predicted adult discrepancy < 2 cm; predict the timing for epiphysiodesis, even if the child was older at the time of consultation; indicate a lift for those with pelvic tilt, and include parents in the surgical treatment decision. Both expert panels agreed to perform a functional and/or anatomical measurement of the lower limb depending on joint involvement and axis alteration.

None of the panels reached a consensus on the following aspects after the consultation process was completed:

1. *Inclusion of the foot in the X-ray measurement:* 100 % of experts in orthopedics recommended to include the foot in children with foot involvement, whereas 83.3 % of experts in imaging studies did not recommend it.
2. *Calibration of the X-ray measurement equipment:* 100 % of experts in orthopedics recommended to place a landmark at the height of the child to calibrate the measurement ruler and thus avoid image size distortion, but this was not agreed by the panel of experts in imaging studies (66.6 %). *Table 4* lists the non-consensual aspects and some of the claims made by experts.

The 39 consensual statements were reorganized into 32 final recommendations, which are detailed in *Table 5*.

DISCUSSION

The Delphi method improved consensus through the inclusion, exclusion, and modification of recommendations in successive rounds. For non-consensual aspects, the Delphi method allowed to analyze experts' claims.

A) Follow-up

Like what was proposed by Bowen et al., the experts agreed that, in addition to clinical measurement, an initial X-ray of the lower limbs should be requested, regardless of the child's age.[9]This would help to assess the current bone discrepancy and, depending on the prediction method used, adult-age discrepancy.

In relation to the evolutionary pattern, Shapiro et al. established five types.[16] Prediction methods for final discrepancy and the optimal timing for epiphysiodesis were developed for the discrepancies that followed the Shapiro I pattern: upward slope.[12,13] However, although it was not ideal, experts recommended using a prediction method, even if the discrepancy did not follow the Shapiro I evolutionary pattern.

Several methods have been described to predict adult-age discrepancy and the timing for epiphysiodesis: Menelaus' remaining growth method, Anderson's arithmetic method, Mosley's straight-line method, and the Multiplier method.[11-13,18] Although there was no agreement in relation to the preference for one method over the other and there is no evidence on which is more accurate, 62.5 % of experts recommended the Multiplier method. Like what was proposed by Friend et al., the expert panel recommended to perform the prediction with at least two different methods to minimize estimation errors.[19]

The timing of epiphysiodesis may be predicted based on chronological or bone age. It is known that bone age is the best remaining growth indicator considering the individual variability in puberty onset. Although no agreement was reached in this regard, some authors recommend using bone age, especially during the pubertal growth spurt.[11,12,20] Some experts in orthopedics described the difficulty to determine bone age and recommended to include the treating pediatrician and/or pediatric endocrinologist to assess the child's remaining growth.

Another important aspect for consensus was the frequency of X-ray control and the prediction of the optimal timing for epiphysiodesis. Repeated X-ray measurements increase prediction accuracy but expose the child to more radiation. In this regard, the expert panel recommended that the frequency of X-ray control should depend on the etiology, magnitude, and course of leg length discrepancy. In prepubed children, whose current and predicted adult-age discrepancy is < 2 cm, the X-ray control should be done every 2-3 years, and the lift heigh should be assesed per the block test.

B) Therapeutic options

The objective of treatment is to match the current and adult leg length. Some authors have mentioned compensatory biomechanical changes in length discrepancy as small as 6 mm.[21,22] However, the bibliography does not include a cutoff point to consider a discrepancy pathological. From a functional perspective, experts agreed that medical treatment (a lift for the short leg) was recommended for patients with a pelvic tilt, regardless of the magnitude of the discrepancy.

Like Gross and Friend,[19,23] surgical treatment

TABLE 1. *Aspects agreed on in round 1*

Statement	Panel of experts in orthopedics: Agreement (%)	Median (range)
A. Follow-up and pre-surgical planning		
It is important to determine the etiology of discrepancy to define follow-up.	100	5 (4-5)
During follow-up, it will be important to define the evolutionary pattern (Shapiro[16]) of discrepancy.	87.5	4.5 (3-5)
It is useful to group the etiology of discrepancy into congenital and acquired.	87.5	5 (3-5)
In addition to clinical assessment, an X-ray for initial measurement is mandatory (first visit), regardless of the child's age.	100	5 (4-5)
Prediction of final discrepancy		
Although it is not optimal, a final discrepancy prediction method should be used, even if the discrepancy does not follow the Shapiro I pattern.[16]	100	4.5 (4-5)
It is necessary to use a prediction method to know the final discrepancy at the beginning of follow-up, regardless of the child's age.	100	5 (4-5)
It is necessary to use a prediction method to know the final discrepancy, regardless of the selected treatment.	100	5 (4-5)
Planning of the timing for epiphysiodesis		
It is necessary to use a prediction method to know the optimal timing for surgery.	100	5 (5-5)
Although it is not ideal, a prediction method of the timing for epiphysiodesis should be used, even if the discrepancy does not follow the Shapiro I pattern.[16]	100	5 (4-5)
It is necessary to perform at least two predictions of the timing for epiphysiodesis before the surgery to minimize errors.	87.5	4 (3-5)
B. Treatment		
The selection of the surgical treatment will depend on the magnitude of the current and the predicted adult discrepancy.	87.5	5 (3-5)
The surgical treatment selection will consider the prediction of the child's final height.	100	5 (4-5)
The height of the lift will be assessed yearly.	100	5 (4-5)
The height of the lift will be assessed every 6 months during puberty.	87.5	4 (3-5)

Statement	Consensus between both expert panels: Experts in orthopedics Agreement (%)	Median (range)	Experts in imaging studies Agreement (%)	Median (range)
C. X-ray request and measurement (lower limbs) Radiology will be considered adequate if it includes the hips and ankles and if the patellae are centered.	87.5	5 (1-5)	100	5 (4-5)
A telemetry of the lower limbs (full-length X-ray image of both legs, from the pelvis to the ankles) should be requested instead of a scanogram (three X-ray exposures: hips, knees, and ankles; the three images are printed in a single X-ray).	100	5 (4-5)	100	5 (4-5)
The femur X-ray measurement is taken between the most proximal point of the femoral head to/and the intercondylar fossa.	87.5	5 (1-5)	83.3	5 (2-5)
The tibia X-ray measurement is taken between the intercondylar eminence to/and the mid-point of the distal tibia at the ankle.	100	5 (4-5)	100	5 (4-5)
The X-ray request should include a note to the radiology technician on the height and location of the lift (right or left foot) so that the pelvis is balanced and measurement errors are prevented.	100	5 (4-5)	83.3	4 (1-5)
X-rays will be taken in recumbent position up to 2-4 years old, based on the available cassette; then, they will be taken with the patient standing and wearing a lift.	87.5	4.5 (2-5)	nc	nc
If the feet are involved, the X-ray measurement should be done from the iliac crest to the floor.	100	4.5 (4-5)	nc	nc
Before performing the leg length X-ray measurement, it is important to calibrate the equipment (for digital X-rays) using a reference pattern.	87.5	5 (3-5)	nc	nc

nc = no consensus (agreement among experts < 80 %).

with epiphysiodesis of the long leg (as a single treatment) was recommended if predicted adult discrepancy was > 2 cm. Although there was no agreement on the maximum recommended limit for the epiphysiodesis, 75 % of experts proposed 5.0 cm as the higher limit then lengthening of the short leg, or a combination of both techniques.

The shortening of the long leg via epiphysiodesis may be definite or temporary.[9,10] Few studies have compared the results of both methods in the long term.[24] In this regard, experts agreed that the selection of the epiphysiodesis would depend on the magnitude of discrepancy and 75 % considered that, in young children with significant discrepancies, temporary epiphysiodesis would prevent the use of a heavy lift during school years.

Another aspect to consider when selecting the surgical procedure is the prediction of final height. All experts recommended working

TABLE 2. *Aspects agreed on in round 2 ´*

Statement	Panel of experts in orthopedics Agreement (%)
A. Follow-up and pre-surgical planning	
During follow-up, it will be important to define the evolutionary pattern (Shapiro)[16] of discrepancy.	100*
It is useful to group the etiology of discrepancy into congenital and acquired.	100*
The frequency of X-ray controls will depend on the magnitude and course of the discrepancy.	87.5
During follow-up, it is important to assess the child's pubertal development.	
Follow-up together with the treating pediatrician and/or pediatric endocrinologist is recommended.	100
Planning of the timing for epiphysiodesis	
It is necessary to perform at least two predictions of the timing for epiphysiodesis before the surgery to minimize prediction errors.	100*
B. Treatment	
The height of the lift will be indicated based on clinical (block test) and X-ray measurements.	87.5
Epiphysiodesis is recommended when predicted adult discrepancy is > 2.0 cm.	87.5
To predict the child's final height, the orthopedist should work together with the treating pediatrician and/or pediatric endocrinologist.	100
To predict the final adult height, the Multiplier[13] method is recommended. Also, 62.5 % of experts recommended using it based on bone age.	100

Statement	Both expert panels Experts in orthopedics Agreement (%)	Experts in imaging studies Agreement (%)
C. X-ray request and measurement (lower limbs)		
X-rays will be taken in recumbent position up to 2-4 years old (or earlier, depending on the child's collaborative attitude), based on the available cassette; then, they will be taken with the patient standing (and wearing a lift if requested in the X-ray order).**	87.5	83.3
The X-ray request should include a note to the radiology technician on the height and location of the lift (right or left foot) so that the pelvis is balanced and measurement errors are prevented.	100	100*
Radiology will be considered adequate if it includes the hips and ankles and if the patellae are centered.	100*	100
The X-ray request should also include the indication to use a reference pattern (ruler, grid, radiopaque sphere, etc.) to calibrate the ruler for measurement.	100	nc
Before performing the leg length X-ray measurement, the equipment should be calibrated (for digital X-rays) using a reference pattern.	100*	nc
If the feet are involved, the X-ray measurement should be done from the iliac crest to the floor.	100	nc
Functional length is used to predict adult discrepancy and the optimal timing for epiphysiodesis.	nc	83.3

* Statements were reviewed by the experts, which helped to improve the percent of agreement.
** Statement modified based on experts' suggestions.
nc: no consensus.

together with the pediatrician and/or pediatric endocrinologist to analyze the growth curve. However, it was not possible to establish the lower limit of adult height that would rule out the shortening of the long leg. Some experts suggested the 3rd centile, which for the Argentine population corresponds to 150 cm and 160 cm in women and men, respectively.[25] Others mentioned that the final height, even if short, would not be determining for the selection of the surgical treatment because it would also depend on the parents' and adolescents' preference based on each procedure's risks and benefits.

Reported medium- and long-term complications after an epiphysiodesis include angular deformity secondary to an incomplete epiphysiodesis and under- or overcorrection.[7,26] In this regard, 75 % of experts recommended clinical and radiological follow-up every 4-6 months until the child reaches his/her adult bone age.

C) X-ray request and measurement

Like Sabharwal et al., there was consensus about requesting a telemetry of the lower limbs instead of a scanogram. Although measurements are comparable, a telemetry helps to assess angular deformities in the same image, thus reducing exposure to radiation.[27] The telemetry should be done with the child in recumbent position up to 2 years old and then standing and wearing a lift. The purpose of wearing a lift for the short leg is to level the pelvis and thus minimize measurement errors. It is worth noting that the pediatrician or orthopedist should include a note to the radiology technician in the order indicating the size and location of the lift.

When taking an X-ray, the distance between the tube and the patient affects actual bone size. The orthopedists agreed on placing a reference pattern at the level of the child, but the experts in imaging studies considered that this was not necessary with the use of digital equipment. The

TABLE 3. *Aspects agreed on in round 3*

Panel of experts in orthopedics	
Statement	**Agreement (%)**
A. Follow-up and pre-surgical planning	
In children with current and predicted adult discrepancy < 2 cm, the frequency of X-ray follow-up may be every 2-3 years before puberty.	100
If consultation is made once a child has reached puberty (late consultation), at least one prediction of the timing for epiphysiodesis should be done.	87.5
B. Treatment	
Lift	
Lifts will be indicated for pelvic tilt while walking, regardless of the magnitude of discrepancy.	100
For controls that do not require to estimate adult discrepancy or the optimal timing for epiphysiodesis, the height of the lift will be indicated based on clinical measurement (block test).	87.5
Surgery	
The surgical treatment selection will consider, in addition to the magnitude of adult discrepancy, the child's age.	87.5
The surgical treatment selection (lengthening of the short leg versus epiphysiodesis of the long leg) will consider the parents' and the child's opinion.	87.5

Statements sent to both panels		
	Experts in orthopedics	**Experts in imaging studies**
Statement	**Agreement (%)**	**Agreement (%)**
C. X-ray request and measurement (lower limbs)		
The total X-ray measurement of the lower limbs is done between the most proximal point of the femoral head to/and the distal midpoint to the tibia "and/or" by adding each segment (tibia + femur). This will depend on whether the child has joint involvement, axis alteration and/or the number of affected segments.**	87.5	83.3

** Statement modified based on experts' suggestions.

TABLE 4. *Non-consensual aspects*

	Experts in orthopedics	Experts in imaging studies	Remarks
Statement	**Agreement (%)**	**Agreement (%)**	
If the feet are involved, the X-ray measurement should be done from the iliac crest to the floor.	100	16.7	"The foot axis is parallel to the central beam...; it's difficult to find an adequate, reproducible anatomical landmark, even in the same child," "if the orthopedist needs it, he/she should indicate it," "it doesn't seem easy to take measurements including the feet," "the order should request the inclusion of the feet, if necessary," "including the feet is difficult but it should be done if the total leg is to be measured," "I always specify that the area from the pelvis to the feet propped up should be shown... specifying what you need is a healthy choice."
A reference pattern (ruler, grid, radiopaque sphere, etc.) should be placed at the level of the patient during the X-ray.	100	50	"In the case of digital equipment, the reference pattern is already incorporated. The orthopedist may add this request in the order if he/she considers that these conditions are not met," "we ask the image to include a ruler because we use different X-ray equipment for comparison," "if the equipment is not calibrated, the difference may be big," "it is critical to consider the distance between the patient and the cassette, which should always be the same," "consensus helps everyone to speak the same language," "if the radiologist is part of the treating team, that's an answer…," "we don't always work with the same X-ray equipment so we prefer comparative scales," "I believe that including a reference pattern will prevent suspicion about whether the X-ray size is real."
Before performing the leg length X-ray measurement, it is important to calibrate the equipment using a reference pattern.	100	66.6	"It depends on the equipment, not all require calibration," "calibration is critical for measurement," "if the system is not calibrated, the difference may be significant."
Using bone age as of 9 years old in boys and 8 years old in girls, considering the onset of puberty, to predict the timing for epiphysiodesis.	75		"I'd rather use the Dimegio method,"[17] "it is difficult to determine bone age," "we don't use bone age due to equipment problems."
Height as of which the shortening of the long leg would be ruled out as a surgical option.			"In case of short stature, some patients prefer a minor surgery (epiphysiodesis) over lengthening; I always give parents the option," "epiphysiodesis compensates 2-4 cm, and does not alter the aesthetics of the final height," "I work with the support of the pediatrician and/or the endocrinologist, who register the child growth curve," "in the case of very short stature (less than 2 SD or below 150 cm), I think it is wise not to stop growth, even if lengthening seems too bloody. In the end, the family has the right to choose... Function should always prevail over aesthetics, but psychological and social aspects should also be considered."
Frequency of post-epiphysiodesis controls. After the epiphysiodesis, X-ray controls of the lower limbs should be done every 4-6 months (depending on the epiphysiodesis technique) until the child reaches his/her adult bone age.	75		"It depends on diagnosis, technique, and the child's age, I mean, it may vary from every 6 months, to yearly or at the end of growth."

analysis of experts' claims points out that this will depend on the equipment and software used at each facility, so it would be wise that each facility developed recommendations on this regard to prevent the distortion of the actual image size and the subsequent prediction error.

The total X-ray measurement of the lower limbs should be done between the most proximal point to the femoral head and the distal midpoint to the tibia or by adding each segment (tibia + femur). The selection will depend on the presence of joint involvement or axis alteration. When the feet are

TABLE 5. *Final consensus*

Statement	Experts in orthopedics Agreement (%)
A. Follow-up and pre-surgical planning	
It is important to determine the etiology of discrepancy to define follow-up.	100
It is useful to group the etiology of discrepancy into congenital and acquired.	100
During follow-up, it will be important to define the evolutionary pattern (Shapiro) of discrepancy.	100
In addition to clinical assessment, an X-ray of the lower limbs for initial measurement is mandatory (first visit), regardless of the child's age.	100
In children with current and predicted adult discrepancy < 2 cm, the frequency of X-ray follow-up may be every 2-3 years before puberty.	100
The frequency of X-ray controls will also depend on the magnitude and course of the discrepancy.	87.5
During follow-up, it is important to assess the child's pubertal development. Follow-up together with the treating pediatrician and/or pediatric endocrinologist is recommended.	100
Prediction of final discrepancy	
It is necessary to use a prediction method to know the final discrepancy at the beginning of follow-up, regardless of the child's age and selected treatment.	100
Although it is not ideal, a prediction method of the magnitude of the final discrepancy is recommended, even if the discrepancy does not follow the Shapiro I evolutionary pattern.	100
Planning of the timing for epiphysiodesis	
It is necessary to use a prediction method to know the optimal timing for surgery (definitive epiphysiodesis). The Multiplier method is preferred by 62.5 % of experts.[13]	100
Although it is not ideal, a prediction method of the timing for epiphysiodesis should be used, even if the discrepancy does not follow the Shapiro I evolutionary pattern.	100
It is necessary to perform at least two predictions of the optimal timing for epiphysiodesis before the surgery to minimize errors.	100
If consultation is made once a child has reached puberty (late consultation), at least one prediction of the timing for epiphysiodesis should be done.	87.5
B. Treatment	
Lift	
A lift will be indicated if a pelvic tilt is observed while walking, regardless of the magnitude of the discrepancy.	100
The height of the lift will be assessed yearly before puberty.	100
The height of the lift will be assessed every 6 months during puberty.	87.5
The height of the lift will be indicated based on clinical (block test) and X-ray measurements.	87.5
For controls that do not require to estimate adult discrepancy or the optimal timing for epiphysiodesis, the height of the lift will be indicated based on clinical measurement (block test).	87.5
Surgery (epiphysiodesis of the long leg or lengthening of the short leg)	
The surgical treatment selection will consider the child's age.	87.5
The surgical treatment selection will consider the magnitude of the current and predicted discrepancy.	87.5
The surgical treatment selection will consider the prediction of the child's final height.	100
To predict the child's final height, the orthopedist should work together with the treating pediatrician and/or pediatric endocrinologist.	100
To predict final adult height, the Multiplier method is recommended; 62.5 % of experts recommend using it based on bone age.	100
To select the surgical treatment, the parents' and the child's opinion will be taken into account, and the risks and benefits of each proposed technique will be analyzed.	87.5
An epiphysiodesis is recommended for predicted adult discrepancies > 2.0 cm. Seventy-five percent of experts recommend performing an epiphysiodesis for predicted adult discrepancies up to 5 cm.	87.5

C. X-ray request and measurement (lower limbs)

	Experts in orthopedics	Experts in imaging studies
Statement	**Agreement (%)**	**Agreement (%)**
Lower limb X-ray request		
A telemetry of the lower limbs (full-length X-ray image of both legs, from the pelvis to the ankles) should be requested instead of a scanogram (three X-ray exposures: hips, knees, and ankles).	100	100
The X-ray request should include a note to the radiology technician on the height and location of the lift (right or left foot) so that the pelvis is balanced and measurement errors are prevented.	100	100
An X-ray will be considered adequate if it includes the pelvis and ankles and if the patellae are centered and to the front.	100	100
X-rays will be taken in recumbent position up to 2-4 years old (or earlier, depending on the child's collaborative attitude), based on the available cassette; then, they will be taken with the patient standing (and wearing a lift if requested in the X-ray order).	87.5	83.3
Lower limb X-ray measurement		
The total X-ray measurement of the lower limbs will be done between the most proximal point to the femoral head and the distal midpoint to the tibia "and/or" by adding each segment (tibia + femur). This will depend on whether the child has joint involvement, axis alteration and/or the number of affected segments.	87.5	83.3
The femur X-ray measurement will be taken between the most proximal point to the femoral head and the intercondylar fossa.	87.5	83.3
The tibia X-ray measurement will be taken between the intercondylar eminence and the mid-point to the distal tibia at the ankle.	100	100

affected, experts in orthopedics agreed to include the foot in the measurement, whereas those in imaging studies contemplated that including the foot would induce a measurement error. Anyway, it was considered that, ultimately, orthopedists should indicate what they need for patient follow-up.

The analysis of experts' claims leads to establish that the treating orthopedist and the imaging test provider should work together and know the strengths and weaknesses of each facility and specify each other's needs to improve the follow-up of these children.

Although the Delphi method has limitations and the level of evidence for an expert consensus is low, this study provides the first recommendations for the clinical and radiological follow-up, pre-surgical planning, and treatment of children with leg length discrepancy in our setting and may be highly relevant for the care of these children. The causes of discrepancy are multiple and its course differs from one child to the other, so these recommendations should be considered in each particular case.

CONCLUSIONS

These are the first recommendations for the follow-up of children with leg length discrepancy agreed by expert consensus.

An aspect that is worth noting in the consultation process was the importance of teamwork among orthopedists, treating pediatrician, imaging specialists and, if necessary, pediatric endocrinologists, in order to improve management planning. ■

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