International Journal of Radiology and Diagnostic Imaging

E-ISSN: 2664-4444
P-ISSN: 2664-4436
www.radiologypaper.com
IJRDI 2023; 6(2): 21-26
Received: 25-01-2023
Accepted: 28-02-2023

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Role of cervical length measured on transvaginal ultrasound at 19-24 weeks in prediction of preterm labor

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DOI: https://doi.org/10.33545/26644436.2023.v6.i2a.321

Abstract
Aim: The aim of the present study was to assess the role of cervical length measured on transvaginal ultrasound at 19-24 weeks in prediction of preterm labor.
Methods: The present study was conducted in the Department of Radio-Diagnosis, Bapuji Hospital, JJM Medical College, Davanagere and pregnant women between 19-24 weeks of gestation were included. 150 pregnant women visiting the Ultrasonography clinic at Bapuji Hospital, JJM Medical College, Davanagere were included. The study was conducted over a period of 1.5 year.
Results: 107 (71.3%) patients had 21 to 25 years of age, 22 (14.7%) patients had 26 to 30 years of age, 18 (12.0%) patients had 31 to 35 years of age and 3 (2.0%) patients had 36 to 40 years of age. 84 (56.0%) patients were Multiparous and 66 (44.0%) patients were Nulliparous. 11(7.3%) patients had ≤20mm cervical length, 22(14.7%) patients had 21 to 30mm cervical length, 36mm (24.0%) patients had 31 to 40 mm cervical length and 81(54.0%) patients had >40mm cervical length. 26 (17.3%) patients had preterm birth and 124 (82.7%) patients had term birth. 44(29.3%) patients had LSCS and 106 (70.7%) patients had VD. Association of age in years vs. cervical length was not statistically significant (p=0.3090). Association of preterm / term labor vs. cervical length was statistically significant (p<0.0001). Association of APGAR score at 1 min vs. cervical length was statistically significant (p<0.0001). Distribution of mean APGAR score at 1 min vs. cervical length group was statistically significant (p<0.0001).
Conclusion: In this study, Short cervical length of < 20 mm in mid trimester resulted in spontaneous preterm delivery and that was statistically significant. Cervical length of 21 to 30 mm also showed significant preterm delivery. The significant association was found in gestational age at delivery with cervical length.

Keywords: Cervical length, preterm birth, ultrasound, transvaginal, transabdominal, transperineal

Introduction
Preterm birth is a common obstetric problem accounting for 11.4% of deliveries in 2011 and prolonged pregnancy ranged from 4-14% [1]. Cesarean section (C.S) rate was 15.4% in 2014-15. Preterm birth remains a major cause of neonatal morbidity and mortality due to complications like necrotizing enterocolitis, intraventricular hemorrhage, respiratory distress syndrome and neurological deficit [1]. There are various methods to predict preterm labor like 1) cervical length 2) fetal fibronectin 3) cortisol level 4) placental hormone level and 5) non-invasive electromyography [2-6].
Post-dated pregnancy has its own complications like fetal macrosomia, oligohydramnios, increased risk of meconium stained liquor and operative intervention [1]. Predictive measures of postdated pregnancy include cervical length measurement by ultrasonography and measurement of fetal fibronectin, cytokine and nitric oxide concentration in cervicovaginal secretions [7]. Some studies have shown that cervical length assessed by transvaginal ultrasonography could predict the possibility of prolonged pregnancy in nulliparous women [7, 8]. It has also been noted that there is an association between cervical length during mid pregnancy and cesarean section due to non-progress of labor at term.
Cervical length, as measured by transvaginal ultrasonography, has been shown to predict preterm birth in asymptomatic low-risk women as well as those presenting with threatened preterm labor. Some studies have evaluated the use of transvaginal ultrasonography in

asymptomatic high-risk women, but differences among them exist regarding the cervical length cut-off defined as abnormal, gestational age at which transvaginal ultrasonography was performed and the gestational age at preterm birth. Previous meta-analyses have addressed the use of transvaginal ultrasonography to predict preterm birth in asymptomatic women, including those with singleton and multiple gestations and those presenting with threatened preterm labor. None of these systematic reviews evaluated high-risk asymptomatic women (such as those with a history of spontaneous preterm birth) separately.

Infants born preterm represent half the children with cerebral palsy, one third of those with abnormal vision, one quarter of those with chronic lung disease, and one fifth of children with mental retardation. In adulthood, there is an increased risk of behavioral problems, lower levels of education achievement, reduced rates of reproductive success and an increased incidence of second generation PTB. Given the substantial and far reaching impact of preterm birth, it is important to recognize patients at increased risk of PTB [9]. Over the last decade, little progress has been made in understanding and preventing preterm birth, and the incidence of spontaneous preterm birth has continued to rise, even in low-risk women [11].

Preterm birth is a leading cause of perinatal morbidity and mortality worldwide. It is responsible for nearly 75% of all neonatal death and neurological handicap [9]. Most preterm births are caused by preterm labor with or without the premature rupture of membranes. Preterm labor is defined as onset of labor before 37 weeks of gestation [10]. But delivery before 34 weeks of gestation has a greater impact on the perinatal morbidity and mortality. By identifying women with high risk of preterm delivery an attempt can be made to reduce the same. The identification of risk factors for preterm birth is therefore, an important challenge currently under investigation. Early prediction of an outcome like preterm birth allows time for interventions.

The aim of the present study was to assess the role of cervical length measured on transvaginal ultrasound at 19-24 weeks in prediction of preterm labor.

Materials and Methods

The present study was conducted in the Department of Radio-Diagnosis, Bapuji Hospital, JJM Medical College, Davanagere and pregnant women between 19-24 weeks of gestation were included. 150 pregnant women visiting the Ultrasonography clinic at Bapuji Hospital, JJM Medical College, Davanagere were included. The study was conducted over a period of 1.5 year.

Method of Collection of Data

150 pregnant women visiting the Ultrasonography clinic at our institution between 19-24 weeks during the routine anomaly scan are included in the study. Cervical length is measured using transvaginal ultrasonography with the standard longitudinal view of cervix while patient's bladder is empty. GE Voluson, GE P9 and GE S7 Expert with TVS probe instrument was used to measure cervical length. It is measured by keeping the probe 3 cm away from the posterior fornix. The cervical length is defined as the length between the internal OS and external OS. Patient is then followed up until they deliver.

Study Tool

All scans are done using GE Voluson, GE P9 and GE S7 Expert Ultrasound machine with Transvaginal probe.

Inclusion Criteria

1. Singleton pregnancy.
2. Women at gestational age 19-24 weeks.

Exclusion Criteria

1. Women with bad obstetric history.
2. Women with obstetric complications like PIH, Pre-eclampsia
3. Women with uterine anomalies, previous history of surgery like conisation etc.
4. Women with medical complications like DM, HTN, renal disorders.
5. Congenital fetal anomalies.

Analysis of Data

The variables analyzed was;

1. The mean cervical length at 19-24 weeks.
2. The cervical length at 19-24 weeks was correlated with gestational age at delivery and the predictive value of the same will be determined.

Study Technique

Patients were recruited from Obstetrics OPD, from labor room and ward. Informed written consent was taken. Subjects fulfilling inclusion criteria were included in the study. Detailed history was taken, general systemic and obstetric examinations carried out and noted in the proforma used for the study.

The Medical history was obtained from the mothers using an interviewer administered structured questionnaire. Thereafter, they had undergone vaginal ultrasonography for cervical length assessment using the Ultrasound Machine and 5MHz transvaginal probe. The cervical length was taken from the point of internal Os to the external Os. The report as regards the cervical length was recorded in the questionnaire, while the rest of the other ultrasonographic findings were recorded in the patients' normal antenatal records. Thereafter, they were followed until their delivery to know its outcome.

Transvaginal Ultrasound Measurement

First studies of the human cervix using transvaginal ultrasound also date back to the 1980s. This technique shares the advantages of trans-labial ultrasound but the probe is even closer to the cervix, and the problem of obscuring by bowel gas is eliminated. It has thus become the preferred, gold standard method of evaluating the cervix in most clinical settings.

Statistical Analysis

For statistical analysis data were entered into a Microsoft excel spreadsheet and then analyzed by SPSS (version 24.0; SPSS Inc., Chicago, IL, USA) and GraphPad Prism version 5. Data had been summarized as mean and standard deviation for numerical variables and count and percentages for categorical variables. Two-sample t- tests for a difference in mean involved independent samples or unpaired samples. Paired t-tests were a form of blocking and had greater power than unpaired tests. A chi-squared test ($\chi 2$ test) was any statistical hypothesis test wherein the sampling distribution of the test statistic is a chi-squared distribution when the null hypothesis is true. Without other qualification, 'chi-squared test' often is used as short for Pearson's chi-squared test. Unpaired proportions were

compared by Chi-square test or Fischer's exact test, as appropriate. One-way analysis of variance (one-way ANOVA) was a technique used to compare means of three or more samples for numerical data (using the F distribution).

Results

Table 1: Demographic data

Age in Years	Frequency	Percent
21 to 25	107	71.3%
26 to 30	22	14.7%
31 to 35	18	12.0%
36 to 40	3	2.0%
Parity		
Multiparous	84	56.0%
Nulliparous	66	44.0%
Cervical Length (mm) group		
≤20	11	7.3%
21 to 30	22	14.7%
31 to 40	36	24.0%
>40	81	54.0%
Preterm/ Term		
Preterm	26	17.3%
Term	124	82.7%
Mode of Delivery		
LSCS	44	29.3%
VD	106	70.7%
APGAR Score at 1 min		
4	2	1.3%
7	8	5.3%
8	16	10.7%
9	23	15.3%
10	101	67.3%

107 (71.3%) patients had 21 to 25 years of age, 22 (14.7%) patients had 26 to 30 years of age, 18 (12.0%) patients had 31 to 35 years of age and 3 (2.0%) patients had 36 to 40 years of age. 84 (56.0%) patients were Multiparous and 66 (44.0%) patients were Nulliparous. 11(7.3%) patients had ≤20mm cervical length, 22(14.7%) patients had 21 to 30mm cervical length, 36mm (24.0%) patients had 31 to 40 mm cervical length and 81(54.0%) patients had >40mm cervical length. 26 (17.3%) patients had preterm birth and 124 (82.7%) patients had term birth. 44(29.3%) patients had LSCS and 106 (70.7%) patients had VD. 2 (1.3%) babies had APGAR score 4 at 1 min, 8 (5.3%) babies had APGAR score 7 at 1 min, 16 (10.7%) babies had APGAR score 8 at 1 min, 23 (15.3%) babies had APGAR score 9 at 1 min and 101 (67.3%) babies had APGAR score 10 at 1 min.

Table 2: Association of age in years: cervical length group

Cervical Length Group (mm)					
Age in Years	**≤20**	**21-30**	**31-40**	**>40**	**TOTAL**
21-25	9	16	21	61	107
Row %	8.4	15.0	19.6	57.0	100.0
Col %	81.8	72.7	58.3	75.3	71.3
26-30	1	3	5	13	22
Row %	4.5	13.6	22.7	59.1	100.0
Col %	9.1	13.6	13.9	16.0	14.7
31-35	1	2	8	7	18
Row %	5.6	11.1	44.4	38.9	100.0
Col %	9.1	9.1	22.2	8.6	12.0
>35	0	1	2	0	3
Row %	0.0	33.3	66.7	0.0	100.0
Col %	0.0	4.5	5.6	0.0	2.0

Chi-square value: 10.5344; p-value: 0.3090

In cervical length ≤20, 9 (81.8%) patients had 21 to 25 years of age, 1 (9.1%) patient had 26 to 30 years of age and 1(9.1%) patient had 31 to 35 years of age. In cervical length 21-30, 16 (72.7%) patients had 21 to 25 years of age, 3 (13.6%) patients had 26 to 30 years of age, 2 (9.1%) patients had 31 to 35 years of age and 1 (4.5%) patient had 36 to 40 years of age. In cervical length 31-40, 21 (58.3%) patients had 21 to 25 years of age, 5 (13.9%) patients had 26 to 30 years of age, 8 (22.2%) patients had 31 to 35 years of age and 2 (5.6%) patients had 36 to 40 years of age. In cervical length >40, 61 (75.3%) patients had 21 to 25 years of age, 13 (16.0%) patients had 26 to 30 years of age and 7 (8.6%) patients had 31 to 35 years of age. Association of age in years vs. cervical length was not statistically significant (p=0.3090).

Table 3: Association of preterm/ term: cervical length group

Cervical Length Group (mm)					
Preterm/ Term	**≤20**	**21-30**	**31-40**	**>40**	**TOTAL**
Preterm	11	5	10	0	26
Row %	42.3	19.2	38.5	0.0	100.0
Col %	100.0	22.7	27.8	0.0	17.3
TERM	0	17	26	81	124
Row %	0.0	13.7	21.0	65.3	100.0
Col %	0.0	77.3	72.2	100.0	82.7
TOTAL	11	22	36	81	150
Row %	7.3	14.7	24.0	54.0	100.0
Col %	100.0	100.0	100.0	100.0	100.0

In cervical length ≤20, 11(100.0%) patients had preterm labor. In cervical length 21-30, 5 (22.7%) patients had preterm and 17 (77.3%) patients had term labor. In cervical length 31-40, 10 (27.8%) patients had preterm and 26 (72.2%) patients had term labor. In cervical length >40, 81 (100.0%) patients had term labor. Association of preterm / term labor vs. cervical length was statistically significant (p<0.0001).

Table 4: Association of APGAR score at 1 min: cervical length group

Cervical Length Group (mm)					
APGAR Score at 1 min	**≤20**	**21-30**	**31-40**	**>40**	**Total**
4	1	0	0	1	2
Row %	50.0	0.0	0.0	50.0	100.0
Col %	9.1	0.0	0.0	1.2	1.3
7	5	0	0	3	8
Row %	62.5	0.0	0.0	37.5	100.0
Col %	45.5	0.0	0.0	3.7	5.3
8	3	5	2	6	16
Row %	18.8	31.3	12.5	37.5	100.0
Col %	27.3	22.7	5.6	7.4	10.7
9	2	5	8	8	23
Row %	8.7	21.7	34.8	34.8	100.0
Col %	18.2	22.7	22.2	9.9	15.3
10	0	12	26	63	101
Row %	0.0	11.9	25.7	62.4	100.0
Col %	0.0	54.5	72.2	77.8	67.3
Total	11	22	36	81	150
Row %	7.3	14.7	24.0	54.0	100.0
Col %	100.0	100.0	100.0	100.0	100.0

In patient with cervical length ≤20, 1 baby (9.1%) had APGAR score 4 at 1 min, 5 (45.5%) baby had APGAR score 7 at 1 min, 3(27.3%) baby had APGAR score 8 at 1 min and 2 (18.2%) baby had APGAR score 9 at 1 min. In

patients with cervical length 21-30, 5 (22.7%) baby had APGAR score 8 at 1 min, 5 (22.7%) baby had APGAR score 9 at 1 min and 12 (54.5%) baby had APGAR score 10 at 1 min. In patients with cervical length 31-40, 2 (5.6%) baby had APGAR score 8 at 1 min, 8 (22.2%) baby had APGAR score 9 at 1 min and 26 (72.2%) baby had APGAR score 10 at 1 min. In patients with cervical length >40, 1 (1.2%) baby had APGAR score 4 at 1 min, 3 (3.7%) baby had APGAR score 7 at 1 min, 6 (7.4%) baby had APGAR score 8 at 1 min, 8 (9.9%) baby had APGAR score 9 at 1 min and 63 (77.8%) baby had APGAR score 10 at 1 min. Association of APGAR score at 1 min vs. cervical length was statistically significant (p<0.0001).

Table 5: Distribution of mean APGAR score at 1 min: cervical length group

	Cervical Length	Number	Mean	SD	Minimum	Maximum	Media n	p- value
APGAR Score at 1 min	≤20	11	7.3636	1.3618	4.0000	9.0000	7.0000	<0.0001
	21 to 30	22	9.3182	.8387	8.0000	10.0000	10.0000	
	31 to 40	36	9.6667	.5855	8.0000	10.0000	10.0000	
	>40	81	9.5679	.9992	4.0000	10.0000	10.0000	

In cervical length ≤20, the mean APGAR score at 1 min (mean ± s.d.) of the babies was 7.3636 ± 1.3618. In cervical length 21-30, the mean APGAR score at 1 min (mean ± s.d.) of the babies was 9.3182 ± .8387. In cervical length 31-40, the mean APGAR score at 1 min (mean ± s.d.) of the babies was 9.6667 ± .5855. In cervical length >40, the mean APGAR score at 1 min (mean ± s.d.) of the babies was 9.5679 ±.9992. Distribution of mean APGAR score at 1 min vs. cervical length group was statistically significant (p<0.0001).

Discussion

Evaluation of the cervix has been used as a tool to predict PTB based on the concept that the cervix acts as an anatomic marker of the underlying pathologic process leading to preterm delivery. The cervical length (CL) has been measured using a digital examination in the past. Investigations using transvaginal ultrasound measurement as the standard confirmed that digital examination underestimates cervical length and the majority of studies found that ultrasound assessment of cervical length is superior to clinical examination for the prediction of PTB.[12] The traditional approach to evaluate the length of the cervix is now using sonographic visualisation. There are three ultrasound approaches that may be used to measure the cervical length. These are the transabdominal (TAU), transperineal (TPU), also known as translabial and the transvaginal ultrasound (TVU) approach [13]. Jafari M *et al* (2009) [14] found that transvaginal sonography (TVS) is the gold standard for investigating cervical length. Transvaginal Sonography is useful, for cervical length evaluations and management of preterm deliveries and cervical insufficiency. Lim K *et al*. (2011) [15] found that the use of the ultrasonographic technique reviewed may help identify women at risk of preterm birth and in some circumstances, lead to interventions that may reduce the rate of preterm birth.

It was found that 11 (7.3%) patients had ≤20 cervical length, 22 (14.7%) patients had 21 to 30 cervical length, 36 (24.0%) patients had 31 to 40 cervical length and 81 (54.0%) patients had >40 cervical length. 12 (8.0%) patients had low birth weight babies, 2 (1.3%) patients had still birth and 5 (3.3%) patients had NICU admission. 2 (1.3%) babies had APGAR score 4 at 1 min, 8 (5.3%) babies had APGAR score 7 at 1 min, 16 (10.7%) babies had APGAR score 8 at 1 min, 23 (15.3%) babies had APGAR score 9 at 1 min and 101 (67.3%) babies had APGAR score 10 at 1 min. The mean age (mean ±s.d.) of the patients was 24.9133 ± 3.8354 years with mean APGAR score at 1 min (mean± s.d.) of the babies was 9.3933 ± 1.0862. Gameraddin M *et al*. [16] (2018) found that the mean TVS CL was 38.2 mm in the second trimester of pregnancy. Peixoto AB *et al*. [19] (2016) found that the median±standard deviation and ranges for the CL measurement (mm) was 37.0±10.7 (range, 8 to 51). CL measurement did not modify significantly with gestational age.

We found that in cervical length ≤20, 9(81.8%) patients had 21 to 25 years of age, 1(9.1%) patient had 26 to 30 years of age and 1(9.1%) patient had 31 to 35 years of age. In cervical length 21-30, 16(72.7%) patients had 21 to 25 years of age, 3(13.6%) patients had 26 to 30 years of age, 2(9.1%) patients had 31 to 35 years of age and 1(4.5%) patient had 36 to 40 years of age. In cervical length 31-40, 21(58.3%) patients had 21 to 25 years of age, 5(13.9%) patients had 26 to 30 years of age, 8(22.2%) patients had 31 to 35 years of age and 2(5.6%) patients had 36 to 40 years of age. In cervical length >40, 61(75.3%) patients had 21 to 25 years of age, 13(16.0%) patients had 26 to 30 years of age and 7(8.6%) patients had 31 to 35 years of age. Association of age in years vs. cervical length was not statistically significant (p=0.3090). Rozenberg P *et al*. [17] (2017) found that ultrasound measurement of cervical length in the general population enables the identification of women at risk for spontaneous preterm delivery. Sezer S *et al*. [18] (2019) found that the risk of premature birth in pregnant women with a cervical length more than 31 mm is minimal.

We found that in cervical length ≤20, 11(100.0%) patients had preterm birth. In cervical length 21-30, 5(22.7%) patients had preterm and 17(77.3%) patients had term birth. In cervical length 31-40, 10(27.8%) patients had preterm and 26(72.2%) patients had term birth. In cervical length >40, 81(100.0%) patients had term birth. Association of preterm / term birth vs. cervical length was statistically significant (p<0.0001). Peixoto AB *et al*. [19] (2016) found that the cervical length (CL) measurement by transvaginal ultrasound between 20 and 24+6 weeks of gestation in a large Brazilian population. A retrospective cross-sectional study was performed with 996 singleton pregnancies. The CL measurement (mm) using the transvaginal ultrasound was obtained in a sagittal view and the callipers positioned

to measure the linear distance between the triangular area of echodensity at the external os and the internal os.

It was found that in cervical length ≤20, the mean gestational age at delivery (mean ± s.d.) was 34.5545 ± .8560 wks. In cervical length 21-30, the mean gestational age at delivery (mean ± s.d.) was 36.8273 ± 2.2837 wks. In cervical length, 31-40, the mean gestational age at delivery (mean ± s.d.) was 37.3889 ± 2.3979 wks. In cervical length >40, the mean gestational age at delivery (mean ± s.d.) was 38.9049 ± 1.0243 wks. Distribution of mean gestational age at delivery vs. cervical length group was statistically significant (p<0.0001).

Fig 1: Transvaginal sonogram showing a slightly shortened cervix

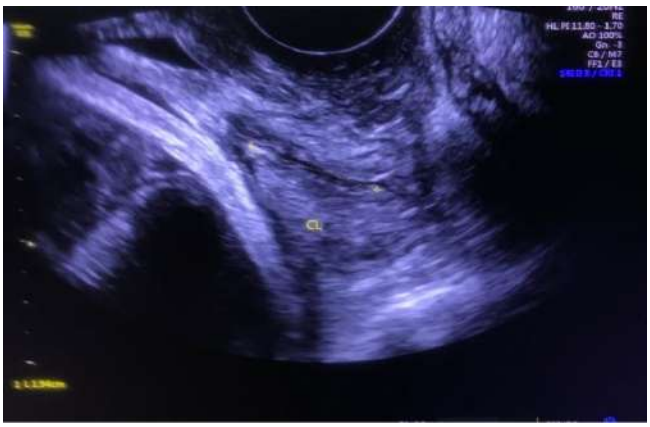

Fig 2: Transvaginal sonogram showing short cervix

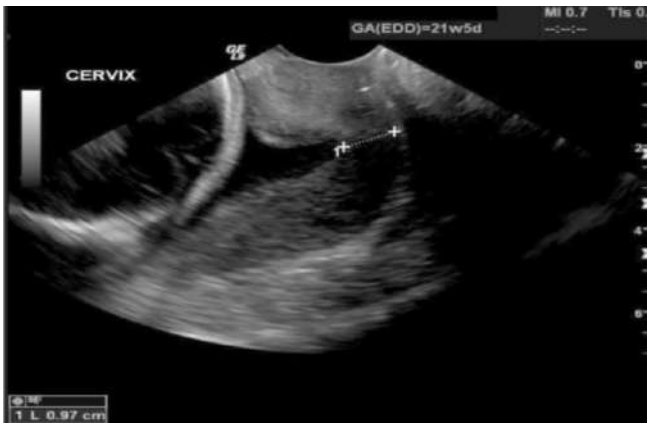

Fig 3: Transvaginal sonogram showing funnelled and short cervix

Conclusion

In this study, Short cervical length of < 20 mm in mid trimester resulted in spontaneous preterm delivery and that was statistically significant. Cervical length of 21 to 30 mm also showed significant preterm delivery. The significant association was found in gestational age at delivery with cervical length. The mode of delivery is associated with the transvaginal sonographic cervical measurement at mid-pregnancy and can be used as a predictive tool to determine the possible outcome of labor and route of delivery. Poor progress in labor is a major indication for Cesarean section at term and contributes significantly to cesarean section rate in long cervical length quartiles of >40mm. So, long cervical length at mid- pregnancy can predict the possibility of cesarean delivery early in pregnancy. Hence, cervical length in mid pregnancy can be of value in predicting the mode of delivery in early pregnancy.

Conflict of Interest

Not available

Financial Support

Not available

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How to Cite This Article
Singh D, Bhagwat KA, Jeevika MU, Tyagi H. Role of cervical length measured on transvaginal ultrasound at 19-24 weeks in prediction of preterm labor. International Journal of Radiology and Diagnostic Imaging. 2023;6(2):21-26.