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Systematic Review and Meta-Analysis of Published Trials Comparing the Effectiveness of Trans anal Endoscopic Microsurgery (TEMS) and Endoscopic Submucosal Dissection (ESD) in the Management of Early Rectal Cancer T1, T2

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Abstract: ***Background: Rectal cancer is one of the most important causes of mortality and morbidity in the western countries. The local excision techniques in treating early rectal cancers significantly reduce the surgical risk but it could be less effective than radical surgery. Trans anal endoscopic microsurgery (TEMS) is a minimally invasive technique that can be used for local excision of early rectal tumors. [1, 2] Endoscopic submucosal dissection (ESD) is an endoscopic alternative to surgical resection of mucosal and submucosal neoplastic lesions.[3] There is an increasing debate about the best local treatment for early rectal cancer. Aim: The aim of this study is to systematically compare the safety and effectiveness of TEMS and Endoscopic mucosal resection for early rectal cancer. Methods: Systematic Review and meta-analysis of published trials comparing the effectiveness of Trans anal Endoscopic Microsurgery TEMS and Endoscopic Submucosal Dissection ESD in the management of early rectal cancer T1, T2. Results: Two comparative trials including 87 patients were studied. There was no significant difference in R0 and En-block resection rate between the TEMS and ESD groups. OR = 1.10, 95% CI [0.15, 8.19], z=0.10 (P=0.92). Local recurrence rate was similar in the two groups. OR = 1.82, 95% CI [0.45, 23.25], z=0.46 (P=0.65). No significant difference in perforation rate between ESD and TEMS group. OR = 1.10, 95% CI [0.15, 8.19], z=0.10 (P=0.92). ESD was accompanied with shorter operation time (mean difference = 46.09, 95% CI[22.16,70.02], Z=3.77 (P=0.0002), however the total hospital stay was similar (SMD = 1.48, 95% CI [-4.69,1.72], z=0.91 (P=0.36). Conclusion: Both TEMS and ESD are equally safe and good options for early rectal cancer treatment. ESD has the advantage of avoiding general anesthesia. However, large randomized controlled studies are needed to build strong evidence, as there is very small number of comparative studies and they are all retrospective observational studies.***

Keywords: Rectal Cancer, TEMS, ESD

1. Background

Rectal cancer is one of the most important causes of mortality and morbidity in the western countries. The local excision techniques in treating early rectal cancers significantly reduce the surgical risk but it could be less effective than radical surgery.

Trans anal endoscopic microsurgery (TEMS) is a minimally invasive technique that can be used for local excision of early rectal tumorsbetween 4 to 18 cm from the anal verge. The procedure permits a stereoscopic, magnified view of a gas-dilated rectum, a feature that allows precise surgery to be performed in a difficult-to-reach area. [1, 2]. The equipment involves an operating proctoscope, insufflation, magnified stereoscopic vision and special surgical equipment (diathermy, forceps and suction). It allows much better vision (three dimensional) and greater flexibility for the surgeon [3]

Endoscopic resection (ER) is an endoscopic alternative to surgical resection of mucosal and submucosal neoplastic lesions and intramucosal cancers. ER includes endoscopic mucosal resection (EMR), which involves snare resection of dysplastic lesions, and endoscopic submucosal dissection (ESD) in which endoscopic tools are used to dissect lesions from the submucosa. ER offers both diagnostic and therapeutic capability. Lesions limited to the mucosa and the superficial layers of the submucosa appear to be the most amenable to endoscopic cure. [4]

In ESD, a specially designed electro cautery knife is used to resect the lesion in one piece (en-bloc) without the use of a snare. This helps in minimizing recurrence and giving better histopathological assessment. The procedure is usually done under sedation or general anesthesia. A colonoscope with a transparent hood is inserted through the anus to visualize the lesion. The submucosa is injected with the fluid to lift the lesion off the submucosa. Then a circumferential mucosal incision would be made with the electrothermal knife around the lesion followed by submucosal dissection. Endoscopic clips may be used to control bleeding and treat small perforations.[5]

There is an increasing debate about the best local treatment for early rectal cancer. The aim of this study is to compare the outcome of these two modalities in treating early rectal cancer Tis, T1, and T2.

2. Methods

2.1. Inclusion criteria

To be included in this review the study must meet these criteria:

1) Randomized, non-randomized and observational published trials comparing the effectiveness and safety of TEMS and ESD in treating early rectal cancer.
2) The studies should include:
   - Evaluation of complications and/or survival and/or recurrence
   - Tis, T1 and T2 rectal cancers

NB. Conference abstracts that fulfilled these criteria were included.

2.2. Data sources and search strategy:

Electronic search of Medline,Embase was conducted for the words:

1) TEMS or Transanal Endoscopic Microsurgery.
2) Early rectal cancer or T1 or T2 rectal cancer.
3) ESD or Endoscopic Submucosal Dissection.
4) Early rectal cancer OR T1 or T2 Rectal cancer.
5) 1 and 2 and 3

The search limits were:

- English language.
- Date: from 2004 to 2014.

Another separate search for Cochrane library was done.
The bibliography references of included study were searched for suitable studies.

2.3 Risk of bias assessment

All included trials were assessed by one viewer using a modified version of the Newcastle-Ottawa Scale for non-randomized studies. The Cochrane Collaboration's Risk of bias tool would be used for randomized trials.

2.4 Data extraction

The full texts of the resulted trials were reviewed by the same reviewer. Data was extracted using predefined form. The extracted data included the title of the study, the journal in which the study was published, the names of the authors, the country and year of the study, the treatment regimen (TEMS or ESD) , the sample size, sex differentiation, age, extent of resection (R0,R1), size of the tumour, distance from anal verge, final histopathology reports, length of the operation, length of stay in the hospital, complications (perforation, bleeding), follow up period, recurrence rate, and mortality rate.

2.5 Statistical analysis

The software package Revman 5.3 provided by the Cochrane Collaboration was used for statistical analysis to achieve a combined outcome. The Odds ratio (OR) , with a 95% confidence interval (CI) was calculated for binary data. The standardized mean difference (SMD) with a 95 % confidence interval was calculated for continuous variables. Heterogeneity was explored using the chi-squared test, with significance set at $P < 0.05$ and was quantified using I2 with a maximum value of 30% identifying low heterogeneity.

Local recurrence and complication rates were analyzed as the primary end points; length of the operation and hospital stay were the secondary end points.

3. Results

After the electronic search 13 studies were found to be suitable for the review. The abstracts and full articles were reviewed by one reviewer. Two comparative studies were found suitable for this review. The bibliographic references from these selected articles were searched for any similar studies. Another search was done using the Cochrane library, which found two systematic reviews. They were assessed by the same interviewer and found they were not suitable to be included. (Table 1: search history on EMBASE, Medline, Figure 1: flow chart showing selection methodology)

(Table 1: search history on EMBASE, Medline)

Table1: Search history on EMBASE, Medline:
1. EMBASE, Medline; TEMS.ti,ab; 724 results.
2. EMBASE, Medline; (Transanal AND Endoscopic AND Microsurgery).ti,ab; 1566 results.
3. EMBASE, Medline; (Early AND rectal AND cancer).ti,ab; 6726 results.
5. EMBASE, Medline; (T1 OR T2 AND Rectal AND cancer).ti,ab; 71818 results.
6. EMBASE, Medline; 1 OR 2; 2196 results.
7. EMBASE, Medline; 3 OR 4; 6999 results.
8. EMBASE, Medline; 6 AND 7; 360 results.
9. EMBASE, Medline; ESD.ti,ab [Limit to: Publication Year 2004-2015]; 5428 results.
10. EMBASE, Medline; (Endoscopic AND Submucosal AND dissection).ti,ab [Limit to: Publication Year 2004-2015]; 5541 results.
11. EMBASE, Medline; (early AND rectal AND cancer).ti,ab [Limit to: Publication Year 2004-2015]; 4429 results.
12. EMBASE, Medline; (T1 OR T2 AND Rectal AND cancer).ti,ab [Limit to: Publication Year 2004-2015]; 34492 results.
13. EMBASE, Medline; 9 OR 10 [Limit to: Publication Year 2004-2015]; 7940 results.
14. EMBASE, Medline; 11 OR 12 [Limit to: Publication Year 2004-2015]; 39499 results.
15. EMBASE, Medline; 13 AND 14 [Limit to: Publication Year 2004-2015]; 94 results.
16. EMBASE, Medline; 8 AND 15 [Limit to: Year 2004-2015]; 13 results.

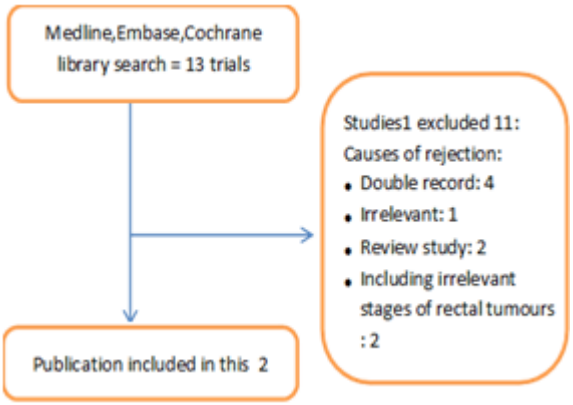

Figure 1: Flow chart showing selection methodology

The accepted studies were:

1) A retrospective study done by **S.U. Park et al.** in South Korea in 2011: They collected data on 63 patients who underwent TEMS or ESD for nonpolypoid rectal high grade dysplasia or submucosa invading tumour at Samsung Medical Centre, Seoul, Korea in the period between January 2007 and April 2011 , all patients had at least 6 months follow up.
2) A retrospective study done **by F.S. Kawaguti et al.** in Brazil in 2013: They collected data on 35 patients with early rectal cancers, who were treated with either ESD or TEMS AT THE Cancer Institute of Saw Paulo University medical school in the period between July 2008 and August 2011.

The characteristics of these two studies were summarized in table 2.

Table 2: Characteristics of included studies

	Park et al.			Kawaguti et al.		
Country, year	South Korea (2012)			Brazil (2013)		
Intervention	ESD	TEM		ESD	TEM	
Number of patients	30	33		11	13	
Age, mean (years)	58.6 (SD8.3)	59.5(SD 11.0)	P= 0.722	62.3 (SD 4.6)	61.5 (SD 9.5)	P=0.81
Sex, M:F	14:16	17:16	P= 0.701			
Tumor characteristics:						
Size, mm	25.4 (SD11.0)	27.8 (15.0)	P=0.476	64.6 (SD 57.9)	43.9 (SD 30.7)	
Location, cm from anal verge	10.5 (SD 4.6)	6.0 (sd 3.6)	P<0.001	2.72 (SD 2.19)	2.85 (SD 2.88)	
Histology						
High grade dysplasia	18 (60%)	24 (72.8%)		1 (9.0%)	5 (38%)	
Submucosal invading cancer	12 (40.0%)	9 (27.3%)		10 (91%)	8 (62%)	
Recurrence:						
Local recurrence	0 (0%)	0 (0%)		1 (9.1%)	2 (15.5%)	
Distant metastasis	0 (0.0%)	0 (0.0%)		0 (0.0%)	0 (0.0%)	
Follow up period, mean(SD) months	20.1 (14.1)	27.2 (11.6)		18.6 +/- 5.4	29 +/- 13.4	
Resection						
En-block resection	29 (96.7%)	33 (100%)		10 (90.9%)	12 (92.3%)	
R0 resection	29 (96.7%)	32 (97.0%)		10 (90.9%)	11 (84.6%)	
Length of procedure and hospital stay:						
Procedure time, min	66.0 min (SD 45.0)	116.4 min (SD58.5)		133 min +/- 94.8	150 min (+/-66.3)	
Hospital stay, days	3.6 days (SD 1.2)	6.6 days (SD 3.5)		3.8 +/- 3.3	4.08 day +/- 1.7	
Need for General Anesthesia	0 (0.0%)	29 (87.9%)		8 (73%)	13 (100%)	
Complications						
Perforation	1 (3.3%)	2 (6.1%)		2 (18%)	2 (15%)	
Bleeding	0 (0.0%)	0 (0.0%)		0 (0.0%)	0 (0.0%)	

3.1 Risk of bias assessment

We used a modified version of the Newcastle-Ottawa Scale for non-randomized studies to critically appraise and assess the risk of bias in these two studies. The results are summarized in Table 3: risk of bias assessment

Table 3: Assessment of the risk of bias on included studies using a modified Newcastle-Ottawa Scale
Key to terms used: Def yes: definitely yes, Def no: definitely no, Prob yes : probably yes , Prob no : probably no.

	Park et al	Kawaguti et al
Selection bias	Prob yes	Def yes
Confidence in sample size	Prob yes	Def yes
Confident that statistical analysis method was appropriate	Def yes	Def yes
Attrition bias	Def no	Def no
Risk of Confounding factors	Prob yes	Prob yes
Confidence in outcome assessment	Def yes	Def yes

Adequate follow-up	Prob yes	Prob no

Park et al. trial:

1) The study size was small: 30 patients underwent ESD and 33 underwent TEMS, which decreases the power of the study.
2) There was no mention about how the patients were allocated to each arm of the study group, suggestion that there may be an important selection bias here. However, there was no important difference in tumour size between the TEMS and ESD group (27.8 and 25.4 mm respectively with P value = 0.476), so this possible selection bias doesn't look very significant.
3) The researchers used suitable statistical analyses for their study: $\chi 2$ test or Fisher's exact test for categorical data. Student's t test or Mann-Witney U test for continuous data. A P value less than 0.05 was considered statistically significant.
4) The follow up period may be acceptable. It was approximately 20 months for ESD group and 27 months for TEMS group (up to 80% of recurrences happen within the first 2 years after surgery[64]); with an important difference from the statistical point of view.
5) There was no concerns about the outcome assessment here as all the outcomes of the interest were objectively assessed

Kawaguti et al. trial:

1) There were more concerns about the study size in this trial as only 11 patients with ESD and 13 patients with TEMS were looked at. This study does not appear to have enough power for it to be statistically relevant.
2) The authors here clearly confirmed a selection bias, as the larger lesions and more proximal lesions were mainly sent for ESD.
3) The follow up period was not as long as Park et al. study, but still we can accept it. The mean follow up period was 18.6 months for the ESD and 29 months for TEMS, with statistically important difference between the two groups shown.

3.2 Assessment of clinical heterogeneity:

The two trials studied patients with early rectal cancers. However, there was a remarkable difference in tumour sizes between the two trials. In the Park et al. trial the mean tumor size for ESD and TEMS group were 25.4 mm and 27.8 respectively, whilst in the Kawaguti trial tumour sizes were 64.6 mm and 43.9 mm for ESD and TEMS group respectively. There was also an important difference between the two trials regarding the distance of the lesion from the anal verge.

3.3. Demographic data:

3.3.1. Park et al. trial:

The study included 63 patients: 33 patients undergo TEMS and 30 patients had ESD.

Age: There was no important difference in the mean age between TEMS and ESD group (59.5 year and 58.6 year respectively, P value= 0.722).
Sex: we have 31 male patients and 31 female patients between the two study groups. There was no statistical difference. (P= 0.71)

3.3.2. Kawaguti et al. trial:

The study included 24 patients, 13 patients had TEMS and 11 patients underwent ESD, with no important difference (P=0.81). There was no data about sex differentiation in Kawaguti trial. Review.

3.4. Tumour characteristics:

3.4.1. Size:

Park et al. trial: the mean tumour size was 25.4 mm in the ESD group and 27.8 mm in TEMS group.

Kawaguti et al. trial: the mean tumour size was 64.6 mm in the ESD group and 43.9 mm in the TEMS group.

Here there was a considerable difference between the two studies, nevertheless the size differences between the two groups in each study was unremarkable (P value was 0.476 and 0.13 in Park and Kawaguti trials resepecively). There was a preference in Kawaguti trial to treat the large tumours with ESD.

3.4.2. Distance from anal verge:

Park et al.: The mean distance from anal verge was 10.5 cm in the ESD group and it was 6.0 cm in the TEMS group. There was an important statistical difference here (P<0.001)
Kawaguti et al.: The mean distance from the anal verge was 2.72 cm in ESD group and 2.85 in the TEMS group, with no significant difference.

There is a remarkable difference in the distance from anal verge between the two trials, again the differences where less between the two legs of each study. There is a trend here to treat the more proximal lesions with ESD rather than TEMS.

3.4.3. Histopathology:

Park et al.: 24 patients (72.8%) of those who underwent TEMS had high grade dysplasia and 9 patients (27.3%) had submucosa-invading cancer, while in the ESD group 18 patients (60%) had high grade dysplasia and 12 patients (40%) had submucosa-invading cancer. There was no statistically important difference between two groups (P=0.290)

Kawaguti et al.: 5 patients in the TEMS group (38%) and 1 patient in the ESD group (9%) had high grade dysplasia, while 8 patients of the TEMS group (62%) and 10 patients of the ESD group (91%) had submucosal invasion.

61% of the TEMS group had high grade dysplasia compared to 46% of the ESD group. 39% of the TEMS group had submucosa invading cancer compared with 54% of the ESD group. This could be explained by the tendency to treat the larger size tumours with ESD (Kawaguti trial).

3.5. Type of anesthesia

TEMS group: In Park trial all 29 patients underwent general anesthesia and one operation was done under spinal anesthesia. While in Kawaguti trial all TEMS procedures were done under general anesthesia.

ESD group: All ESD procedures in Park trial were performed with patients under conscious sedation with IV midazolam and pethidine, while in Kawaguti trial 3 procedures were done under conscious sedation and the rest of the procedures were done under general anesthesia (8 patients).

Overall, most of TEMS cases in both trials were performed under general anesthesia and most of ESD cases were done under conscious sedation.

3.6. Resection rate:

TEMS group: In Park et al. trial there were 32 patients (97%) who had R0 resection and 33 patients (100%) had en-block resection. While in Kawaguti trial there were 11 patients (84.6%) who had R0 and en-block resection.

ESD group: In Park trial there were 29 patients (96.7%) who had en-block resection, they all had R0 resection as well. In Kawaguti trial 10 patients ((90.9%) achieved R0 resection.

Combined analysis: R0 resection rate: There was no heterogeneity (Chi^2=0.06, df= 1, P=0.81, I^2= 0%) among the included studies. In the random effects model (OR = 0.45, 95% CI [0.07,3.00], z=0.83 (P=0.41).

There was no significant difference in R0 resection rate between the TEMS and ESD group.

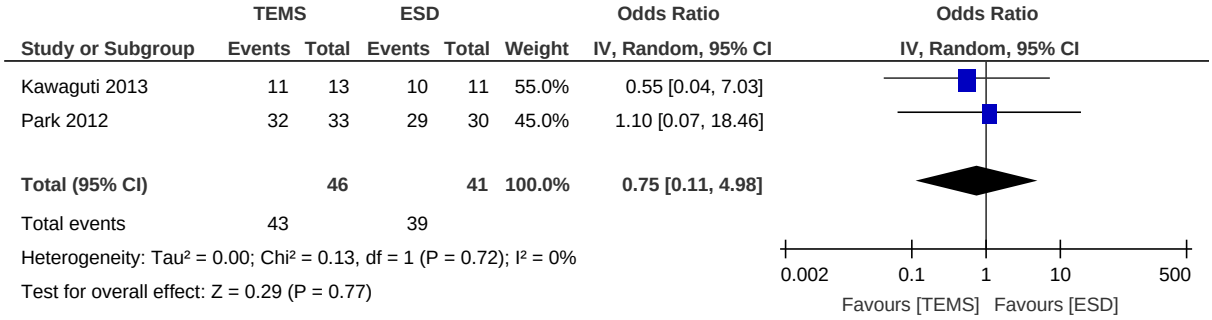

Figure 2: Forest plot of R0 resection rate following TEMS and ESD

3.7. En-block resection rate: There was no heterogeneity (Chi^2=0.75, df= 1, P=0.39, I^2= 0%) among the included studies. In the random effects model (OR = 1.10, 95% CI [0.15,8.19], z=0.10 (P=0.92). Again, there is no significant difference in the en-block resection rate between the TEMS and ESD group.

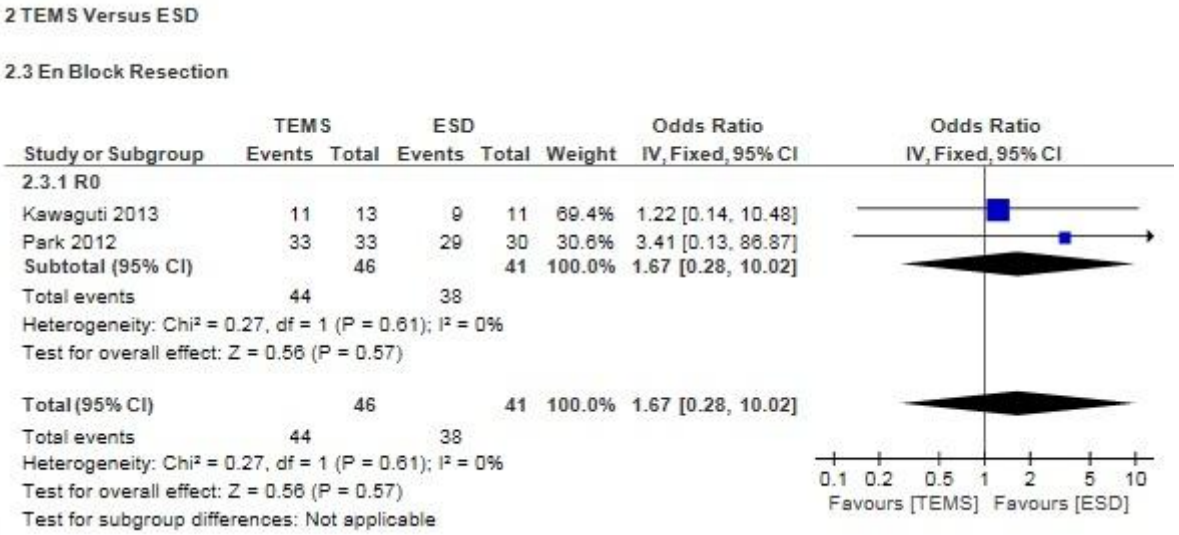

Figure 3: Forest plot of En-block resection rate following TEMS and ESD

3.8. Recurrence

3.8.1. Local Recurrence: TEMS Group: Park et al. trial: There was no local recurrence in the TEMS group, the follow up period here was 27.2 months (SD:11.6)

Kawaguti et al. trial: The mean follow up time here was 29 (SD = 13.4) months. There were two patients which had local recurrence at 3 and 9 months, they both were diagnosed as incomplete resection. The mean follow up time here was 29 (SD=13.4) months.

ESD Group: Park et al.: There was no local recurrence in the ESD Group. The follow up period was 20.1 months (SD14.1).

Kawaguti et al. trial.: There was one identified case of recurrence in the ESD group. The mean follow up time was 18.6+/- 5.4 months.

Combined analysis: In the random effects model (OR = 1.82, 95% CI [0.45,23.25], z=0.46 (P=0.65). There is no significant difference between TEMS and ESD group in local recurrence rates after the procedure.

3.8.2. Distant metastasis: There was no distant metastasis in both trials in any of the studied groups (TEMS, ESD).

3.9. Mortality rate: There were no mortalities in either groups in both Park and Kawaguti et. al. trials.

3.10. Complication rate:

3.10.1. Perforation:

TEMS group: In Park et al. trial there were 2 perforations (6.1%); the same number of which occurred in the Kawaguti et. al trial (2 cases which made 15% of TEMS cases).

ESD group: In Park et al. trial there was one case of perforation (3.3%), while there were two cases which complicated with perforation in Kawaguti et al. trial.

Combined analysis: There was no heterogeneity (Chi^2=0.75, df= 1, P=0.39, I^2= 0%) among the included studies. In the random effects model (OR = 1.10, 95% CI [0.15, 8.19], z=0.10 (P=0.92). Again there is no significant difference in the en-block resection rate between the TEMS and ESD group.

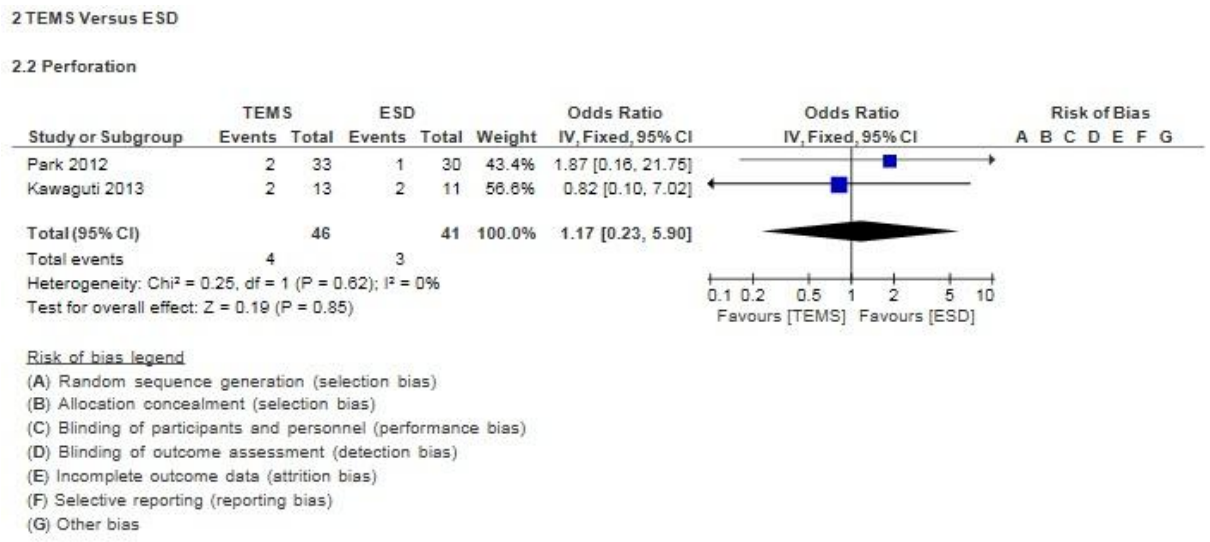

Figure 4: Forest plot of perforation rate following TEMS and ESD

3.10.2. Bleeding

TEMS group: In Park et al. trial and Kawaguti trial there were no cases complicated with bleeding. ESD group: In both Park and Kawaguti trials there was no bleeding.

Here there were no documented cases and therefore cannot comment on this complication.

In Park et al. trials there was one patient in the TEMS group who had postoperative wound dehiscence and underwent emergency surgery for repair and drainage.

4. Duration of the Procedure

TEMS group: In Park et. al trial the total procedure time was 116.4 min (SD= 58.5), while it was 150 min (SD= 66.3) in Kawagati et. al trial.

ESD group: The total procedure time was 66.0 min (45.0) in Park et. al trial and it was 133 min +/- 94.8 in Kawagati et. al trial.

Combined analysis: There was no heterogeneity (Chi^2=0.84, df= 1, P=0.39, I^2= 0%) among the included studies. In the random effects model ((standard mean difference = 46.09, 95% CI [22.16,70.02], Z=3.77 (P=0.0002). The length of the procedure was significantly shorter after the ESD procedure.

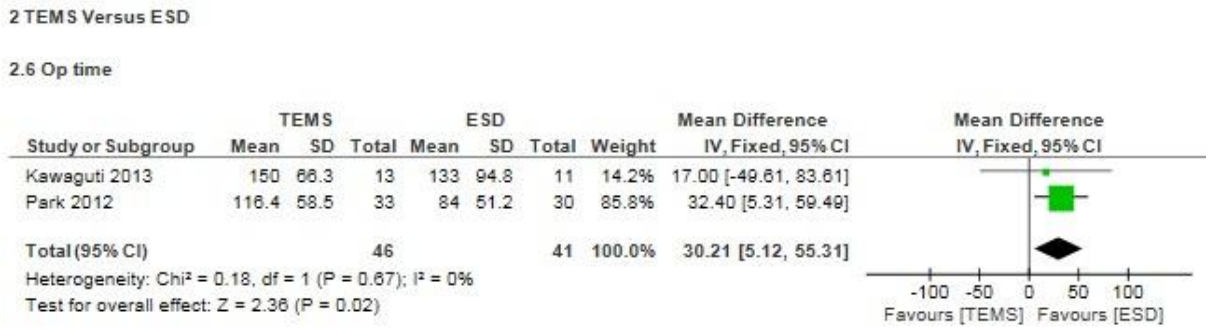

Figure 5: Forest plot of the duration of the procedure

5. Hospital stay

TEMS group: The total stay in the hospital was 6.6 days (SD 3.5) in Park et. al trial and it was 4.08 day +/- 1.7 day in Kawagati et al. trial.

ESD group: In Park et al. trial the means hospital stay was 3.6 days (SD 1.2), while it was 3.8 +/- 3.3 days in Kawagati et al trial.

Combined analysis: There was significant heterogeneity (Chi^2=6.61, df= 1, P=0.01, I^2= 85%) among the included studies. In the random effects model (SMD = -1.48, 95% CI [-4.69, 1.72], z=0.91 (P=0.36).

There was no significant difference in the total hospital stay between the TEMS and ESD groups.

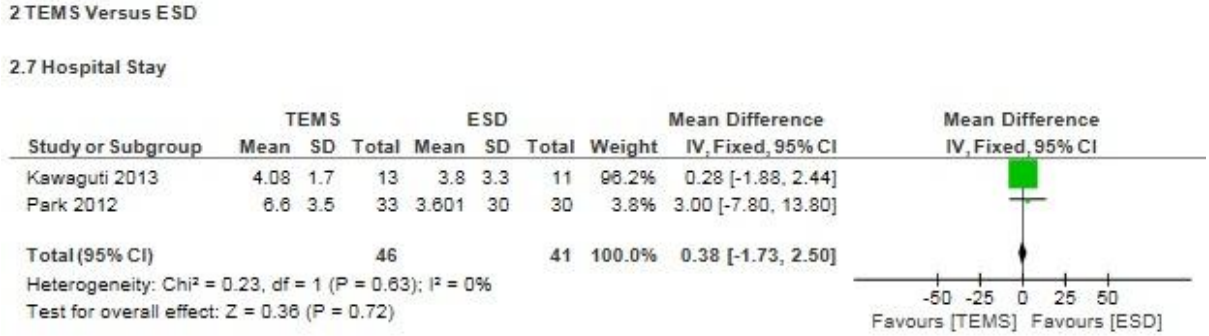

Figure 6: Forest plot of the total length of stay in the hospital after TEMS and ESD

6. Discussion and Conclusion

We don't think that this systematic review adds strong evidence to the current knowledge about TEMS and ESD procedures because of the small number of studies looked at. The total number of patients studied is also small (87 patients). There were very few studies comparing ESD and TEMS in treating early rectal cancers. I think we need non-randomized controlled studies comparing these two procedures to be able to find out if there was any preference of one over another. Regardless of this weakness the summarized results from this review are as follows:

Completion of the resection: This systematic review showed that there was no significant difference in R0 or En-Block resection between the TEMS and ESD group. Taking into account that there was a definite selection bias, at least in Kawaguti trial, where there was an intention to treat the large size tumors with ESD, increasing the assumption that ESD was at least as effective as the TEMS in treating large rectal lesions.

Recurrence rate: There was no distant metastasis in any of the included studies. There was no significant difference in local recurrence between the two groups. In fact, there were only two recurrences in Kawaguti trial. and they were diagnosed as incomplete resection 3 and 9 months after the procedure, there were both treated with repeated TEMS. The local recurrence rate in Kawaguti trial was higher than the recurrence rate after radical surgery (recurrence rate after stage I rectal cancer resection 8.5%, here it was 9.1,15.5% with the ESD and TEMS respectively). However, because of the small sample size, we don't think that this result is important from the statistical point of view.

Mortality: The mortality rate was 0% in both studies. This result is significantly much less than mortality after major resections. The mortality rate here is smaller than radical surgery. (0-6% with APR)

Complications rate: There was no significant difference in perforation rate between the TEMS and the ESD group. There was no bleeding in either of the two groups during the post-operative period.

Duration of the procedure and total stay in the hospital: This systematic review showed that the duration of the ESD procedure was significantly less than the TEMS, however there was no significant difference in total length of hospital stay.

From this we can conclude that both TEMS and ESD are safe and efficient procedures that can be used to treat early rectal cancer. ESD had the advantage of being performed under conscious sedation rather than general anesthesia which is usually used with the TEMS. ESD had a similar R0 resection with TEMS bearing in mind the intention to do the large tumors with ESD and the length of the procedure is shorter than the TEMS one.

References

[1] Buess G. Endoscopic operative procedure for the removal of rectal polyps. Endoscopy. 1984;6:254-61.2. De Graaf EJ, Burger JW, Van Ijsseldijk AL, Tetteroo GW, Dawson I, Hop WC. Transanal endoscopic microsurgery is superior to transanal excision of rectal adenomas. Colorectal Disease. 2011 Jul;13(7):762-7.
[2] De Graaf EJ, Burger JW, Van Ijsseldijk AL, Tetteroo GW, Dawson I, Hop WC. Transanal endoscopic microsurgery is superior to transanal excision of rectal adenomas. Colorectal Disease. 2011 Jul;13(7):762-7.
[3] Palma P, Horisberger K. Transanal Endoscopic Microsurgery-State of the Art. INTECH Open Access Publisher; 2011 Sep 22.
[4] Onaitis M, Ludwig K, Perez-Tamayo A, Gottfried M, Russell L, Shadduck P, Pappas T, Seigler HF, Tyler DS. The Kraske procedure: A critical analysis of a surgical approach for mid-rectal lesions. Journal of Surgical Oncology. 2006 Sep 1;94(3):194-202.
[5] Interventional procedure overview of endoscopic submucosal dissection of lower gastrointestinal lesions,Nice report, July 2009
[6] Park YM, Cho E, Kang HY, Kim JM. The effectiveness and safety of endoscopic submucosal dissection compared with endoscopic mucosal resection for early gastric cancer: a systematic review and metaanalysis. Surgical endoscopy. 2011 Aug; 25(8):2666-77.
[7] Kawaguti FS, Nahas CS, Marques CF, da Costa Martins B, Retes FA, Medeiros RS, Hayashi T, Wada Y, de Lima MS, Uemura RS, Nahas SC. Endoscopic submucosal dissection versus transanal endoscopic microsurgery for the treatment of early rectal cancer. Surgical endoscopy. 2014 Apr; 28(4):1173-9.