

## Three dimensional/four dimensional ultrasound-guided embryo transfer using the maximal implantation potential point

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**Objective:** To evaluate the use of maximal implantation potential (MIP) point in conjunction with a 3D/4D ultrasound in order to facilitate embryo transfers and potentially improve pregnancy rate.

**Design:** Retrospective, observational study.

**Setting:** IVF Center.

**Patient(s):** Between October 1, 2002, and August 27, 2004, 1,222 patients who underwent 3D/4D-ultrasound guided embryo transfers.

**Intervention(s):** Ultrasound-guided embryo transfer using a 3D/4D ultrasound machine and the MIP point.

**Main Outcome Measure(s):** Procedure feasibility with improved visibility.

**Result(s):** Embryo transfers were performed at the MIP point and the pregnancy rate was 36.66% (average patient age, 37.6 years). Physicians reported improved visualization and a greater accuracy in the placement of embryos within the uterine cavity.

**Conclusion(s):** The MIP point can be immediately identified and individualized for each patient. Embryo transfers at the MIP were associated with good implantation and pregnancy rates. (*Fertil Steril*® 2005;84:500–3. ©2005 by American Society for Reproductive Medicine.)

**Key Words:** Maximal implantation potential point, 3D/4D ultrasound, embryo transfer

The success rates in patients undergoing IVF has improved tremendously over the past few years. Better ovulation induction protocols as well as great improvements in the IVF laboratory have greatly contributed to the increased pregnancy rate. One area that has received more attention than usual is the embryo transfer technique. While many variations exist in the preparation of the cervix, the type of transfer catheter used, the duration of the transfer and the use of trial transfers, most physicians in the US as well as other countries are now performing embryo transfers under ultrasound guidance. Since the introduction of the ultrasound as an aid to embryo transfer, physicians have reported a greater ease of transfer, and more accurate placement of the embryos within the uterine cavity. The patients also enjoy watching their embryos, distracting them from the actual transfer procedure.

Ultrasound-guided embryo transfer has been around since 1985 and has become almost universal in the past three

years. Multiple studies have shown higher pregnancy rates when performing embryo transfers in conjunction with ultrasonography (1–4). The advantages of ultrasound-guided embryo transfers include the facilitation of embryo transfer as well as the physician's ability to visualize catheter and embryo placement.

Although 2D ultrasound guidance has been increasingly used, controversy exists regarding the ideal placement of the embryos with the uterine cavity (Fig. 1). Various studies have been published regarding the ideal area of embryo transfer. However, these studies represent only generalized locations, not taking into consideration that uterine anatomy varies among women.

Three-dimensional ultrasound, which was recently introduced, enables us for the first time to visualize the uterine cavity as a whole (Fig. 2A). Three-dimensional sonography can improve visualization of the uterus in patients with normal anatomy and especially in those with uterine anomalies such as bicornuate uterus. Along with the 3D ultrasound we used a maximal implantation potential (MIP) point as our target for embryo transfers. The MIP point is defined below and is shown in Figure 2.

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**FIGURE 1**

Conventional 2D ultrasound image.



*Gergely. Embryo transfer using the 3D/4D ultrasound. Fertil Steril 2005*

The uterine cavity resembles an inverted triangle and the fallopian tubes open into the cavity, one in each of the upper regions of the triangle. The MIP is the intersection of these two imaginary lines, one originating in each fallopian tube, within the inverted triangle. In natural pregnancies, fertilization usually occurs in the ampullary segment of the fallopian tube and the pre-embryo then travels down to the uterus and usually implants in the anterior or posterior segment of the uterus close to its trajectory line, where the endometrium is the thickest and has the greatest blood flow. In patients undergoing IVF, the fallopian tubes are bypassed, placing the embryos directly into the uterus. By using the MIP point, placement of the embryos occurs where nature intended.

Because of individual anatomic differences, the MIP point can be individually tailored. Further advances in 3D ultrasonography as well as the introduction of 4D sonography have enabled us to visualize the transfer catheter in real time as it moves towards its target, the MIP point.

## MATERIALS AND METHODS

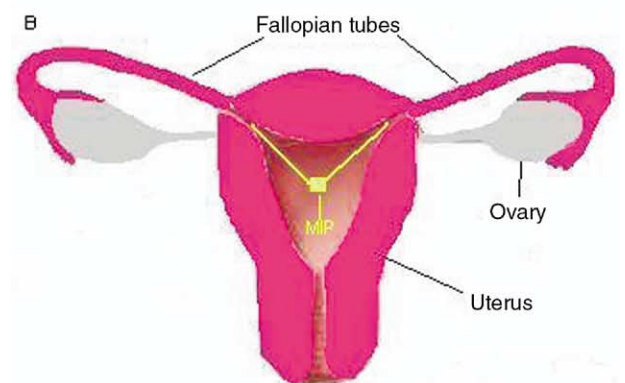
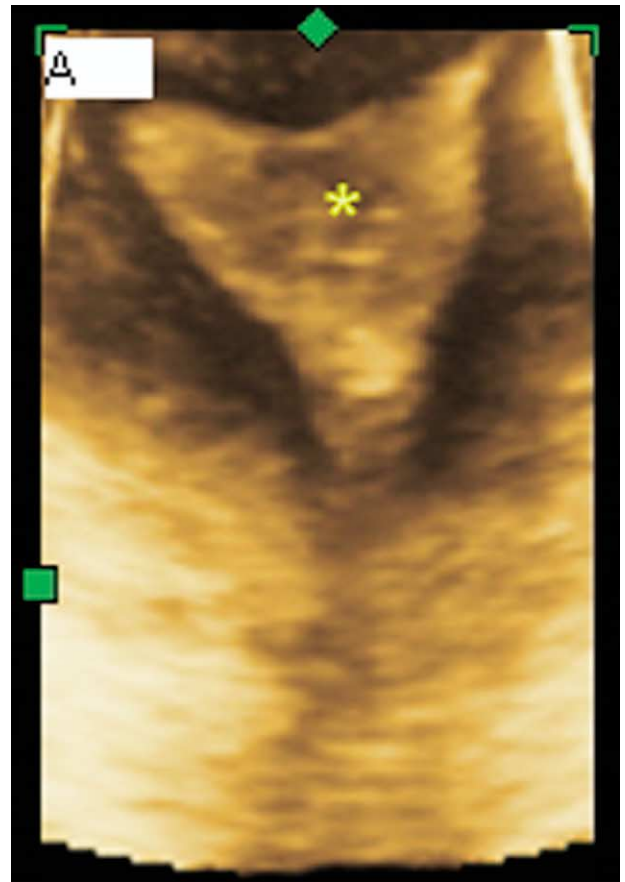
From October 1, 2002, to August 27, 2004, all patients that underwent 3D/4D ultrasound guided transfers at our center were included in the study. Institutional review board approval was not needed in this case, because this article describes our experience with this technique at our center during this time period. Embryo transfers were performed in all patients anywhere from two to six days after oocyte retrieval in the following manner.

Once the bladder was determined to be adequately full, by using abdominal 2D ultrasound initially, the 3D ultrasound mode was then employed revealing the uterine

cavity, after which the MIP point was identified. The physicians sterilized the perineum in the usual fashion using culture media and inserted a speculum into the vagina. Once the MIP was identified by the 3D/4D ultrasound machine, the physician inserted the transfer catheter that he or she deemed appropriate.

**FIGURE 2**

(A) 3D ultrasound image. The maximal implantation potential (MIP) point is marked with an asterisk. (B) Anatomic diagram demonstrating the MIP point.



*Gergely. Embryo transfer using the 3D/4D ultrasound. Fertil Steril 2005*

## FIGURE 3

Embryo flash is confirmed on 3D ultrasound after transfer in area of maximal implantation potential.



Gergely. Embryo transfer using the 3D/4D ultrasound. *Fertil Steril* 2005

The catheter tip was visualized during the entire insertion procedure and once the internal os was passed, the 4D mode was employed. This allowed us to follow the catheter tip in real time on towards the predetermined MIP point. Once the tip of the catheter was over the MIP point, the embryos were released inside the cavity and an embryo flash was visualized (Fig. 3). The empty catheter was then gently withdrawn, and checked by the embryologist for remaining embryos. Once

clearance was received, the speculum was removed and the patient was kept in a supine position for 30 minutes before being discharged.

## RESULTS

During all embryo transfer procedures, the uterine cavity was well visualized using 3D/4D ultrasonography and the MIP point was well identified. During the time period evaluated, a total 1,222 patients underwent 3D/4D ultrasound guidance utilizing the MIP point. Their average age was 37.6 years and the pregnancy rate was 36.66%. A total of 16 different physicians performed the transfers, with two of the physicians accounting for 65% of the transfers. The ultrasound was performed by the same individual in all cases. Physicians reported improved visualization and were accepting of the incorporation of the 3D/4D sonography in the embryo transfer.

## DISCUSSION

Although the IVF technology and success rates have come a long way, there still remains room for improvement. The pregnancy rate is highly influenced by the quality of the embryos, the receptivity of the endometrium, and the transfer technique (5).

There is still no consensus of what the ideal choice for implantation is for embryos. In a study by Baba et al. (6), embryos were transferred to the midfundal area in 60 patients. Among the 22 pregnancies, 80% of the embryos implanted in the areas to which they were transferred.

The location of embryo transfer in respect to the uterine anatomy also varies among physicians. Some studies have shown that the optimal location for embryo transfer is .5–1 cm away from the uterine fundus (3), although some believe that the tip of the catheter should be 1.5 cm from the uterine fundus (2). Others have shown that transfer should be in the lower to middle uterine segment (7). And in a study by Pope et al. (8), it was demonstrated that for every additional millimeter the embryos are placed away from the uterine fundus, the clinical pregnancy rate increases by 11%. In a recent randomized study by Franco et al. (9), embryos were deposited in the lower or upper half of the endometrial cavity and there was no difference in pregnancy or implantation rates.

From early work on surgically removed uteri by Adams et al. (10), implantation was found to take place in the upper half of the uterine cavity, most on the posterior wall of the uterus. Therefore, the MIP point provides the logical spot, mimicking implantation in the general population. Since 3D/4D ultrasonography allows us to identify the MIP point with great ease, it is now possible to use the combination of MIP and 3D/4D sonography to accomplish embryo transfers accurately.

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