

## Conversion of Hip Fusion to Total Hip Arthroplasty

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### Abstract

Hip fusion provides adequate pain relief for various end-stage hip pathologies. However, this comes at the expense of motion, restricting most of daily-living activities. Conversion to a THA has been shown to restore range of motion, relieve pain, and decrease stress in adjacent joints. Furthermore, THA can enhance quality of life, improve function, and restore the ability to perform activities of daily living. This systematic review study to evaluate the indications, clinical outcome, complications, overall satisfaction and change in quality of life in patients underwent conversion of hip fusion to total hip arthroplasty. The electronic database search yielded 2154 studies; 1352 studies were duplicated so removed. After removal of 422 for language and sampling defects, 380 were screened according to inclusion and exclusion criteria. Only 11 studies were eligible, so included in qualitative synthesis in the current systematic review. Regarding the outcome assessment, 8 out of 11 studies used Harris hip score (HHS) for outcome evaluation, 2 out of 11 studies used Mayo score and only one study out of 11 studies used Merle d'Aubigné scale. The all included studies showed significant improvements of the scores postoperative and enhanced outcomes. Despite the lack of well deigned studies on the conversion to total hip arthroplasty, the present systematic review provides some evidence that total hip arthroplasty can aid to restore range of motion, relieve pain, and decrease stress in adjacent joints.

**Keywords:** Hip arthrodesis, Hip arthrodesed, Hip fusion and Hip conversion.

### 1. Introduction

Hip fusion follows several hip pathologies such as inflammatory arthropathies mostly ankylosing spondylitis, hip dysplasia, hip infection and post-traumatic cases. Also, surgical fusion used as treatment of end stage hip disease. It's recommended for mono-articular disease in younger patients to provide pain relief on the expense of motion [1-3].

Spontaneously or surgically fused hip joint can lead to a durable, painless and stable hip. However, in the long term, a fused hip can be a significant source of pain and lead to degenerative changes in the lumbar spine, contralateral hip, and ipsilateral knee, especially when the hip is in suboptimal functional position. Also, patients can experience gait disturbances, instability, and leg-length discrepancy [4, 5].

Gomez and Morcuende appear to have presented the first report of a hip arthrodesis in the English language with an osteotomy of the femoral head to create an abducted position of the leg [6], Whitehouse and Duncan described the use of an iliofemoro-plasty to achieve an extra-articular fusion of the hip [7].

Gomes et al. suggested the use of a combination of intra and extra-articular bone auto-grafting to address the problem of nonunion and pseudarthrosis [8]. Mesa and Wedemeyer described ischiofemoral arthrodesis with the use of a tibial strut autograft [9, 10].

The addition of a subtrochanteric osteotomy, medialization of the femoral head and the addition of lateral plate fixation were subsequently recommended in order to improve fusion rates [11, 12].

Hip arthrodesis restricts several daily activities, leads to gait abnormalities, alters the biomechanics of adjacent joints results in ipsilateral knee, contralateral hip and lumbar spine degeneration in long term [3, 13].

Conversion to a total hip arthroplasty (THA) has been shown to restore range of motion, relieve pain, and decrease stress in adjacent joints [1]. Furthermore, THA can enhance quality of life, improve function, and restore the ability to perform activities of daily living [14]. However, the conversion procedure is challenging due to the effects of the previous disease, past surgical procedures, altered bone and soft tissue anatomy, stability, and physiology of the joint [5, 14].

Prognostic factors are controversial and the most important are age at conversion, presence of hardware, years from fusion to conversion, intra-articular versus extra-articular arthrodesis, surgical approach, implant selection and gluteus muscle status [14].

Although some studies have reported on conversion THA, the limited number of studies and patients make it difficult to draw consistently, meaningful conclusion on such procedure.

### 2. Methods

The electronic database search yielded 2154 studies; 1352 studies were duplicated so removed. After removal of 422 for language and sampling defects, 380 were screened according to inclusion and exclusion criteria. Only 11 studies were eligible, so included in qualitative synthesis in the current systematic review Fig (1).

#### Inclusion criteria

- Clinical studies with at least two years of follow up
- English literatures only.

#### Exclusion Criteria

- Non-human studies.
- Studies that were written in languages other than English.

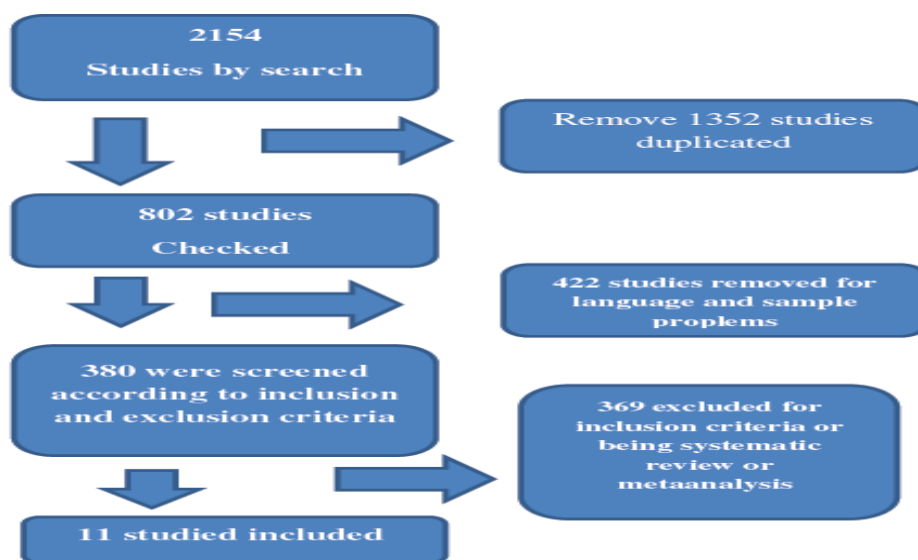
- Cadaveric studies.
- Reviews, commentaries, and general discussion papers not presenting data on impacts.
- Articles describing techniques only.

#### Assessment of Level of Evidence

- Database for search was collected from PubMed and MEDLINE up to the year of 2018. Results from entire researches were collected, assessed and analyzed.
- After reviewing these studies, there was a selection process of these abstracts based upon specific inclusion and exclusion criteria; we included studies performed in patients who were adult that underwent conversion to total hip arthroplasty from a fused (surgical or spontaneous) hip.
- We excluded case reports, case series with less than five fusions, mean follow-up of less than two years and review articles. Additionally, cross-referencing was performed to include additional relevant

articles. We evaluated the mean age, duration and cause of arthrodesis, indications for conversion, length of follow-up, surgical techniques and approaches, complications, clinical outcome scores, and satisfaction statements.

- We assessed the primary indication for fusion, either spontaneous or surgical arthrodesis and subclassified it as traumatic, infectious, autoimmune, osteoarthritis/degenerative joint disease (DJD), childhood related disorders, failed arthroplasty, and other (which also included unknown or non-reported).
- The data for each study was compiled into an electronic spreadsheet. Then, with the aid of statistical software, we calculated the weighted mean of complication rates. Additional descriptive statistics were performed with every other outcome measure. This study was performed without any external funding.



**Fig (1)** Flowchart showing the results of electronic database search and the exclusion as well as the inclusion of studies for the current systematic review.

#### Statistical analysis

Statistical analysis for the overall cohort of studies was performed using a commercially available statistical software package (SAS 9.3; SAS Institute, Cary, NC). Descriptive statistics were calculated for each study, and parameters were analyzed. For each variable, the number and percentage of studies that reported the variable were calculated. Variables were reported as weighted average and weighted range where applicable.

#### 3. Results

This review included just 11 studies that were eligible, so included in qualitative synthesis in the current systematic review. There were two level I studies [6,7], Four level II studies [3, 4, 5, 8], three level III studies [1, 2, 10], two level IV studies [9, 11].

The studies included 314 patients with 336 hips. The mean age was distributed among studies as  $48.3 \pm 12.52$ , males represented 56.6% while females represented 43.4%. Some studies (4 studies) assessed BMI with a mean of  $26.35 \pm 3.11$ . In addition, the mean time from fusion to THA was distributed as  $27.154 \pm 4.22$  among studies Table (1).

Mean follow up period was  $11.52 \pm 2.6$  years. Regarding the outcome assessment, 8/11 studies used Harris hip score (HHS) for outcome evaluation, 2/11 used Mayo score and only one study used Merle d'Aubigné scale. The mean pre-operative HHS score among the studies, which used it was  $50.95 \pm 14.3$ , which increased significantly to  $83.0 \pm 7.95$  indicating a significant improvement ( $p=0.00^{**}$ ). Regarding the Mayo score, the mean pre-operative score  $51.25 \pm 0.58$  while the postoperative score was  $81.85 \pm 0.86$

indicating a significant improvement ( $P=0.00^{**}$ ). Regarding the Merle d'Aubigné scale, Villanueva et al. (2013) was the only study that used it and it was improved significantly from a mean of  $14.2 \pm 3.5$  to a mean of  $17.5 \pm 2.2$  ( $P=0.0008^{**}$ ). Marked Leg length discrepancy (LLD) was assessed in 9 out of the 11 studies, and varied from 5.5% to 40% with a mean of  $26.7\% \pm 7.3$ . Failed arthrodesis was assessed in studies and ranged from 0.0% to 23.0% with a mean

percentage of failure  $8.56 \pm 5.52$ . Regarding the survival after operation, it was assessed in 5/11 studies with a mean value of  $12.58 \pm 3.85$  years Table (2).

The rate of complications among the selected 11 studies is shown in Table (3). It varied from 5.5% to 40%. The commonest reported complications were sustained pain, followed by infection, while the least common complications were zirconium head injuries and vascular injuries.

**Table (1)** Basic demographic and clinical data in each study.

	N patients	N hips	Age mean $\pm$ SD	Male	Females	BMI	Time from fusion to THA
Flesher et al., 2018 [15]	23	23	49.0 $\pm$ 9.0	13	10	25.2 $\pm$ 3.1	32.0 $\pm$ 8.0
Peterson et al., 2009 [16]	30	30	52.5 $\pm$ 10.25	12	18	NA	32.6 $\pm$ 7.5
Morsi, 2008 [17]	18	19	51.7 $\pm$ 7.32	11	7	NA	21.2 $\pm$ 7.12
Schäfer et al., 2000 [18]	15	15	NA	8	7	NA	30.2 $\pm$ 10.52
Katz et al., 2003 [19]	30	30	52.85 $\pm$ 15.52	16	14	26.58 $\pm$ 3.21	32.1 $\pm$ 14.2
Abdel al et al., 2010 [20]	12	15	26.58 $\pm$ 9.85	4	12	NA	16.4 $\pm$ 7.85
Villanueva et al., 2013 [14]	20	21	58.0 $\pm$ 16.52	7	13	NA	39.0 $\pm$ 13.5
Fairen et al., 2011 [14]	98	98	52.7 $\pm$ 14.52	67	31	27.04 $\pm$ 1.85	22.6 $\pm$ 7.51
Celiktas et al., 2017 [13]	28	40	52.7 $\pm$ 14.52	16	12	NA	22.6 $\pm$ 7.51
Sadek et al., 2018 [21]	22	27	34.0 $\pm$ 11.52	19	3	NA	17.0 $\pm$ 6.47
Aderinto et al., 2012 [22]	18	18	53.0 $\pm$ 17.0	5	13	25.69 $\pm$ 7.85	33.0 $\pm$ 11.0

**Table (2)** Clinical result and outcome.

	Follow up time/y	Hips	Evaluation by	Pre	Post	Marked Leg length discrepancy	Failed	Survival years
Flesher et al., 2018	15.0 $\pm$ 8.0	23	HHS	59.0 $\pm$ 15.0	89.0 $\pm$ 20.0	5 21.7%	0 0.0%	15.0 $\pm$ 0.0
Peterson et al., 2009	10.0 $\pm$ 2.0	30	Mayo	52.0 $\pm$ 10.0	81.2 $\pm$ 12.0	NA	7 23.3%	10.0 $\pm$ 3.0
Morsi, 2008	7.1 $\pm$ 2.3	19	HHS	54.5 $\pm$ 18.8	93.5 $\pm$ 5.2	1 5.5%	1 5.5%	NA
Schäfer et al., 2000	15.0 $\pm$ 5.0	15	HHS	51.0 $\pm$ 15.0	86.0 $\pm$ 8.0	6 40.0%	2 13.4%	15.0 $\pm$ 3.0
Katz et al., 2003	30	30	HHS	58.0 $\pm$ 14.0	88.0 $\pm$ 10.0	NA	3 10.0%	NA
Abdel al et al., 2010	15.0 $\pm$ 5.0	15	HHS	42.0 $\pm$ 5.0	76.0 $\pm$ 25.0	4 33.3%	1 6.7%	13.0 $\pm$ 1.0
Villanueva et al., 2013	20	21	Merle d'Aubigné scale	14.2 $\pm$ 3.5	17.5 $\pm$ 2.2	4 20.0%	2 10.0%	NA
Fairen et al., 2011	98	98	HHS	60.2 $\pm$ 6.7	83.3 $\pm$ 7.5	32 32.6%	10 10.2%	NA
Celiktas1 et al., 2017	3.2 $\pm$ 1.1	40	HHS	33.3 $\pm$ 8.6	74.6 $\pm$ 8.6	10 25.0%	2 5.0%	NA
Sadek & Abo-El-soud, 2018	8.0 $\pm$ 2.0	27	HHS	46.0 $\pm$ 10.5	78.0 $\pm$ 8.0	6 27.2%	1 3.7%	7.5 $\pm$ 1.0
Aderinto et al., 2012	10.0 $\pm$ 1.5	18	Mayo	50.5 $\pm$ 15.7	82.5 $\pm$ 7.5	6 33.3%	1 5.5%	NA

**Table (3)** Complication distribution among studies.

	Hips	Infection	Dislocation	Zirc Head fractur	Nerve injuries	Septic stem loosing	Sustained pain	Vascular injuries	Overall
<b>Flesher et al., 2018</b>	23	1 4.3%	0 0.0%	1 4.3%	0 0.0%	1 4.3%	7 30.4%	0 0.0%	8 34.7%
<b>Peterson et al., 2009</b>	30	0 0.0%	2 6.7%	0 0.0%	0 0.0%	0 0.0%	2 6.7%	0 0.0%	4 13.4%
<b>Morsi, 2008</b>	19	0 0.0%	1 5.2%	0 0.0%	0 0.0%	0 0.0%	7 36.8%	0 0.0%	7 36.8%
<b>Schäfer et al., 2000</b>	15	2 13.4%	0 0.0%	0 0.0%	2 13.4%	2 13.4%	0 0.0%	0 0.0%	6 40.0%
<b>Katz et al., 2003</b>	30	3 10.0%	1 3.3%	0 0.0%	0 0.0%	0 0.0%	5 16.7%	0 0.0%	7 23.3%
<b>Abdel al et al., 2010</b>	15	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	5 33.3%	1 6.7%	5 33.3%
<b>Villanueva et al., 2013</b>	21	2 9.5%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	2 9.5%
<b>Fairen et al., 2011</b>	98	0 0.0%	3 3.1%	0 0.0%	4 4.1%	0 0.0%	18 18.3%	0 0.0%	25 25.5%
<b>Celiktas1 et al., 2017</b>	40	1 2.5%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	4 10.0%	0 0.0%	4 10.0%
<b>Sadek &amp; Abo-Elsoud, 2018</b>	27	0 0.0%	1 3.7%	0 0.0%	0 0.0%	0 0.0%	2 7.4%	0 0.0%	2 7.4%
<b>Aderinto et al., 2012</b>	18	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	1 5.5%	0 0.0%	1 5.5%

#### 4. Discussion

Patients with surgically or spontaneously fused hips are often dissatisfied with their overall function and the debilitating effect on adjacent joints. Therefore, in properly selected patients, hip fusion takedown and conversion to total hip arthroplasty (THA) can result in improved function and decreased pain [5].

Therefore, the current work was conducted as a systematic review study to evaluate the indications, clinical outcome, complications, overall satisfaction and change in quality of life in patients underwent conversion of hip fusion to total hip arthroplasty.

The electronic database search yielded 2154 studies 1352 studies were duplicated so removed, after removal of 422 for language and sample problems 380 were screened according to inclusion and exclusion criteria. Only 11 studies were eligible, so included in qualitative synthesis in the current systematic review. These studies included 314 patients with 336 hips. The mean Age was distributed among studies as  $48.3 \pm 12.52$ , male represent 56.6% and female 43.4%.

Sadek and Abo-Elsoud (2017) [21] retrospectively reviewed 27 fused hips (22 patients) converted to total hip arthroplasty between 2001 and 2013. A total of 19 male and three female patients had hip fusion for an average of 17 years (range: 6–32), with mean age at conversion of 34 years (range: 22–55). Patients were followed for a mean of 96 months (range: 36–168). Harris hip score improved significantly from 46 to 78 at the last follow-up with a mean flexion range of 85°.

Abductor lurch with positive Trendelenburg sign was present in eight hips. All but two patients were satisfied with the result. Complications included two cases of heterotypic ossification, one partial sciatic nerve palsy that later recovered, and one hematoma formation.

Peterson et al. (2009) [16] evaluated pain, function, and the factors influencing survivorship of total hip arthroplasties after previous arthrodesis between 1985 and 2000 and compared these results with those obtained in prior years with the same procedure and in the same institution. Thirty patients who had previous spontaneous or surgical arthrodesis were included. The minimum follow-up was 2 years. Seven failures were identified (23%). The overall survival free of failure was 86% at 5 years and 75% at 10 years. At last follow up, 27 of the 30 patients (91%) had no or slight pain, 26 (87%) had a limp, and 18 (61%) needed a gait aid.

Celiktas et al. (2017) [13] retrospectively reviewed 28 (40 hips) prospectively followed patients in whom ankylosed hips were converted to THA between 2010 and 2014. The average age at conversion operation was  $40.8 \pm 9.8$  years. The ankylosis had lasted  $20.4 \pm 13.0$  years (range 3–56) before conversion surgery. The mean follow-up period was  $39.9 \pm 10.6$  months (range 24–60). The mean preoperative HHS was  $33.3 \pm 8.6$  (range 18–50) and the mean HHS at the final follow-up was  $74.9 \pm 8.6$  (range 52–97). There was a statistically significant increase in HHS ( $p = 0.0001$ ). HHS was excellent in 1, good in 6, fair in 14 and poor in 7 patients. Increase in HHS was lower than 20 points in

one patient (18 points), and one patient required two-staged exchange procedure due to deep infection. Trendelenburg sign was positive in 12 hips. There was limb length inequality in 11 patients (mean 0.5 cm, range 1–3 cm).

Flesher et al. (2018) [15] studied 23 hips that underwent conversion of a fused hip to THA using a 3D CT scan-based custom titanium. The mean follow-up was 15 years. Femur anteversion ranged from  $-29^{\circ}$  to  $80^{\circ}$ . HHS improved from 59 to 89 points and average range of motion was  $88^{\circ}$  for flexion. Back pain decreased in 62%, and knee pain decreased in 42%. The mean post-operative leg-length discrepancy was 7.8 mm. No intra-operative complications occurred. One aseptic stem loosening for mechanical failure was observed. An overall analysis of satisfaction statements revealed mostly positive feedback.

In the study by Sadek and Abo-Elsoud (2017) [21] patients were followed-up for a mean of  $96\pm 30$  months (range: 36–168). the mean preoperative limb length discrepancy (LLD) improved from 2.5 cm (range: 1–4) to 0.5 cm (range: 0–2) with successful equalization of leg length in 16 patients. Functional outcome was graded excellent in six patients, good in 12, fair in seven, and poor in two patients. Harris hip score improved significantly from 46 (range: 20–56) preoperatively to 78 (range: 42–97) at the last follow-up.

In the study by Villanueva et al. (2013) [14] mean range of flexion was  $95^{\circ}$  ( $45^{\circ}$ – $130^{\circ}$ ), mean internal rotation was  $25^{\circ}$  ( $0^{\circ}$ – $45^{\circ}$ ), mean external rotation was  $35^{\circ}$  ( $15^{\circ}$ – $60^{\circ}$ ), and mean abduction and adduction were both  $40^{\circ}$  ( $20^{\circ}$ – $50^{\circ}$ ). Leg-length discrepancy averaged 3.5 cm before surgery, and mean surgical correction averaged 3 cm (0–5 cm). Pelvic tilt was observed before surgery in 17 cases and, after surgery, it improved or was corrected in 11 of the 17 cases.

In the study by Schäfer et al., (2000) [18] fifteen patients underwent THA after spontaneous or operative fusion of a hip joint. At follow-up examination 5.4 years postoperatively, the Harris Hip Score averaged 86. Six patients were pain-free, 7 had less pain, 2 felt no improvement of pain. The Trendelenburg sign was negative or mild in 8 patients and moderate to severe in 7. Aseptic loosening of 2 stems and 2 deep infections required revision surgery. Authors concluded that this operation can lead to satisfactory results even after a long duration of the arthrodesis. However, full function with no pain and a negative Trendelenburg sign could be obtained in only 20% (3/15) of the cases.

In our study, the overall complication distribution among studied was varies from 5.5% to 40%. The most prevalent complication was sustained pain followed by infection and the least prevalence was in vascular injuries. Failure was assessed in papers from 0.0% to 23.0% with mean percentage of failure  $8.56\pm 5.52$ , regard Survival of operation was assessed in 5/11 studies with mean survival of  $12.58\pm 3.85$  years. Marked Leg length discrepancy assessed in 9/11 from

studied papers and varied from 5.5% to 40% with mean percentage of  $26.7\pm 7.3$ .

## 5. Conclusion

Despite the lack of well deigned studies on the conversion to total hip arthroplasty, the present systematic review provides some evidence that total hip arthroplasty can aid to restore range of motion, relieve pain, and decrease stress in adjacent joints. Total hip arthroplasty can also improve the survival and enhance quality of life through improvement of function and thus the ability to perform daily activities. However, this technique may also be associated with some complications experienced by the patients.

## Limitations of the study

Small number of included studies (eleven study) that needed to be more to reach a consistent and meaningful conclusion on such procedure conclusion.

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## Conflict of Interest Nil

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