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The Camitz transfer and its modifications: a review

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Abstract

The Camitz procedure involves transfer of the insertion of the palmaris longus tendon with a strip of the palmar aponeurosis to the insertion of abductor pollicis brevis in order to improve thumb opposition, and is usually done when severe carpal tunnel syndrome results in complete wasting of the thenar muscles. We carried out a systematic review of the published reports of this procedure. Analysis of available outcome data showed improvement in overall hand function in 86–100% of patients undergoing the original Camitz procedure. Several modifications of the original Camitz transfer have been described, with most focusing on the incorporation and placement of pulleys. All studies are limited by their small sample sizes. Overall, there is a lack of studies comparing the Camitz transfer with other opponensplasty techniques and comparing the various modifications of the original procedure.

Level of evidence: IV

Keywords

Camitz, opponensplasty, tendon transfer, carpal tunnel, opposition

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Introduction

The Camitz opponensplasty is a transfer of the insertion of the palmaris longus (PL) tendon with a strip of the palmar aponeurosis to the insertion of the abductor pollicis brevis (APB) (Camitz, 1929). This transfer creates a longitudinal axis of pull on the base of the thumb in line with the forearm, which aids opposition (Lee at al., 2003). The main indication for the Camitz transfer is advanced carpal tunnel syndrome, when significant thenar atrophy has resulted.

Helge Georg Botvid Camitz (1883–1953) was a Swedish surgeon who graduated from Gothenburg University in 1916. During his medical career, he worked for the Red Cross during the Finnish Civil War, and in the Gothenburg Children's Hospital and the Invalid Institution of Gothenburg. Very little biographical information is available although he published on several other orthopaedic topics, including nonunion of fractures of the femoral neck.

Although the Camitz procedure is well-known, relatively little has been written about it. The purpose of this study was to provide a systematic review of publications about the Camitz opponensplasty and its variations.

Methods

We searched PubMed, Google Scholar and the Cochrane Library using the term 'Camitz'. Papers not in English were excluded, unless a translated version was available. One reviewer (B. R.) manually screened appropriate articles by review of titles and abstracts. All articles reporting use of the Camitz transfer, suggested modifications or associated outcomes were included. Broader articles on opponensoplasty, not focusing on Camitz's method, were excluded. Fifteen full-text articles were subsequently downloaded and selected for inclusion based on their relevance. Further review of citations in the initial papers yielded an additional four articles for inclusion. The reference list shows the 19 included articles.

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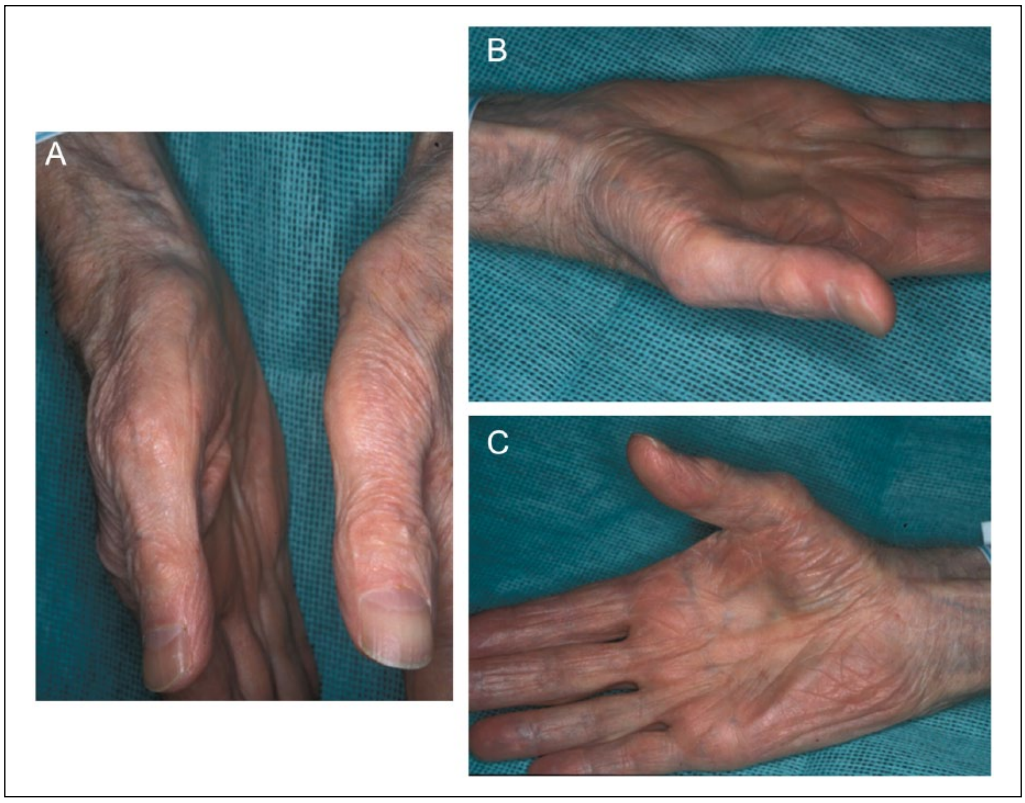

Figure 1. (A) A 75-year-old man with severe bilateral thenar wasting caused by advanced carpal tunnel syndrome. (B) Position of the right hand at rest after Camitz transfer. (C) Attempted opposition. The thumb is abducted from the palm and the action in palmaris longus can be seen.

Results

Indications

The Camitz transfer is used most commonly in long-standing or advanced carpal tunnel syndrome (CTS), where there is significant thenar muscle atrophy and complete absence of muscular action potentials, secondary to median nerve compression (Hattori et al., 2014; Kato et al., 2014; Naeem and Lahiri, 2013; Park et al., 2010). Patients with loss of thenar function are unable to produce the pinch strength necessary for common activities of daily living, such as dressing, writing and picking up coins. Some authors advocate the loss of this last function as an indication for the transfer (Yip et al., 2009). Restoration of pinch strength is the goal of opponensplasty, although the Camitz transfer in fact restores mostly abduction of the thumb and is often referred to, more accurately, as an abductorplasty (Kato et al., 2014; Park et al., 2010; Terrono et al., 1993) (Figure 1).

Although most often used in adults, one small case series has demonstrated its applicability in children (Baluch and Borschel, 2010).

Apart from its use in advanced compression neuropathy of the median nerve, the procedure has also been used after loss of function in the median nerve from other causes, such as fracture of the distal radius, invasion of the distal median nerve by tumours and proximal neuritis (Baluch and Borschel, 2010). In this last condition patients should be warned of the potential for loss of function in the transferred tendon if relapses should occur in the future.

Technique

Since the original publication by Camitz (1929) several authors have given descriptions for this operation. It is very often done at the same time as open carpal tunnel release (OCTR) (Kato et al., 2014; Littler and Li, 1967; Ting and Weiland, 2002). This combination of procedures was first described by Littler and Li (1967), and is sometimes referred to as the Camitz-Littler operation.

The procedure can be done under regional anaesthesia, using an axillary block or intravenous (Bier's) block (Kang et al., 2012; Naeem and Lahiri, 2013; Ting and Weiland, 2002; Wan et al., 2007). An initial incision is made from the distal palmar crease to 2 cm proximal to the distal wrist crease along a line parallel to the tendon of PL (Naeem and Lahiri, 2013;

Wan et al., 2007). Some authors have described linear incisions, whereas others have used zigzag incisions to reduce scar contracture. Care must be taken to identify and preserve the palmar cutaneous branch of the median nerve, as it travels superficial to the flexor retinaculum. A second incision is made obliquely over the metacarpophalangeal joint (MCPJ) of the thumb (Camitz, 1929; Foucher et al., 1991; Naeem and Lahiri, 2013; Park et al., 2010; Terrono et al., 1993; Ting and Weiland, 2002; Wan et al., 2007). Through the initial incision the PL tendon is dissected free along with a 1–2 cm-wide strip of the palmar aponeurosis. This fascial extension adds length to the transferred PL tendon to allow its attachment at the insertion of the APB. The extension can be trimmed as required. The tendon is passed through a subcutaneous tunnel between the midline and thenar incisions. The insertion can also be into the dorsal capsule of the MCPJ of the thumb. A number of papers report optimal insertion is on the dorso-radial aspect of the MCPJ (Camitz, 1929; Terrono et al., 1993; Wan et al., 2007).

The tension of the PL tendon is then adjusted with the thumb in full opposition (Park et al., 2010, Wan et al., 2007). The mean operative time in a case series by Foucher at al. (1991) was reported to be 24 min. The operated hand is immobilized in plaster for 4 weeks with night splinting for a further 1–3 weeks.

Modifications

In the 85 years since Camitz's paper, many different techniques for opponensplasty have been described, with tendons from almost all forearm muscles being used as motor units (Bunnell, 1938; Kato et al., 2014). Despite the wide variety of procedures that are available, the Camitz transfer has remained in use and several modifications have been described. Most focus on the incorporation and placement of pulleys to improve pronation of the thumb. Figure 2 illustrates the placement of pulleys for the two principal modifications discussed below.

The earliest modification was suggested by Bunnell (1938), who noted that a PL tendon transfer through a pulley near the pisiform bone and with the insertion on the dorsal-ulnar aspect of the MCPJ produced a pull mostly in line with APB fibres. The technique of using an ulnar-based pulley has subsequently been shown to be efficacious in several studies (Kang et al., 2012; Naeem and Lahiri, 2013; Park et al., 2010).

MacDougal et al. (1995), Matsumura et al. (1999) and Kato et al. (2014) have all produced studies on the efficacy of passing the PL tendon through a pulley placed on the radial aspect of the released flexor retinaculum. This also makes the pull of the transferred PL tendon in line with the fibres of APB. MacDougal et al. (1995) and Matsumura et al. (1999) also discuss differing methods for attaching the tendon into the insertion of the APB.

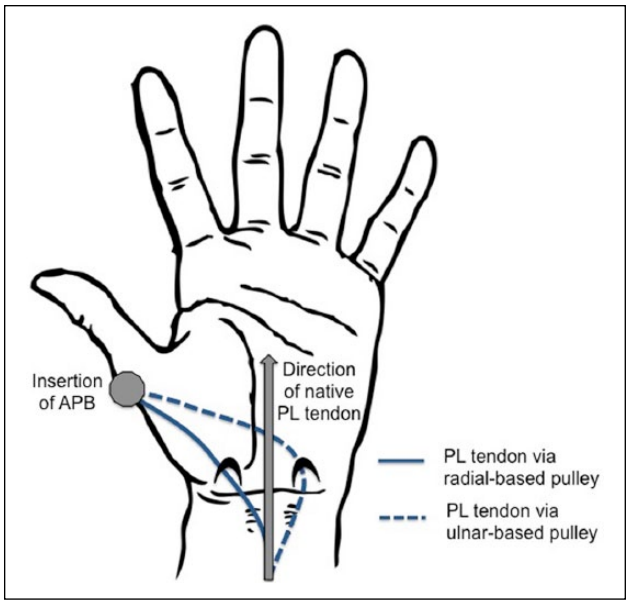

Figure 2. Line diagram representing the position of pulleys and the palmaris longus tendon in the modifications of the Camitz transfer.

Outcomes

There are several studies that report on outcome after the Camitz transfer. Some are reports of the original Camitz technique and others of the efficacy of modifications. As various outcome scores are used in these studies, the data provided are not suitable for inclusion in a meta-analysis. Therefore it is difficult to determine clearly the efficacy and outcomes of this procedure. Table 1 gives an overview of the nine studies that report outcomes, with details on sample sizes and outcome measures used.

The most commonly reported outcome measure is the Kapandji opposition score (Kapandji, 1986). This assesses the point to which a patient can oppose the thumb pulp, with different points being assigned different scores. A score of 1 corresponds to opposition to the radial border of the middle phalanx of the index finger and a maximum score of 10 is given if the distal palmar crease is reached at the base of the little finger. A range of absolute improvements in scores from 0.8 to 7 is seen across studies, with 71% improving on their original score (Naeem and Lahiri, 2013; Wan et al., 2007). This broad range hints at the immense variability in these datasets. Eighty percent of patients achieve the same score as the unaffected hand and

Table 1. Overview of the nine studies that reported outcomes of the Camitz transfer, including sample size, duration of follow-up and outcome measures.

Study	Procedure	Hands operated (n)	Mean age (years)	Mean follow-up (months)	Outcome scores used								
					Kapandji score	DASH score	CTSI score	Palmar abduction	Radial pinch abduction strength		Pronation angle	Spatial rotation	Side pinch
Park et al. (2010)	Camitz transfer	12	58	25	✓			✓				✓	
Wan et al. (2007)	Camitz transfer	21	70	6	✓					✓			
Terrono et al.(1993)	Camitz transfer	33	65	17					Subjective measures only				
Foucher et al. (1991)	Camitz transfer	88	59-62	39	✓			✓			✓	✓	
Kato et al. (2014)	Camitz transfer	7	73	3 and 12	✓	✓		✓	✓	✓	✓		✓
	Modified Camitz transfer (pulley at radial edge of FR)	13	64										
Hattori et al. (2014)	Modified Camitz transfer (pulley at radial edge of FR)	46	70	14		✓	✓	✓		✓			
Kang et al. (2012)	Modified Camitz transfer (pulley at ulnar edge of FR)	9	59	24	✓			✓					
Naeem and Lahiri (2013)	Modified Camitz transfer (pulley at ulnar edge of FR)	6	63	5	✓								
Baluch and Borschel (2013)	Camitz transfer + nerve repair/grafting	4	11	Not mentioned	Subjective measures only								

CTSI, carpal tunnel syndrome instrument; DASH, Disabilities of the Arm, Shoulder and Hand; FR, flexor retinaculum.

overall the mean Kapandji score is reported to increase by 20% (Foucher et al., 1991; Park et al., 2010).

Increases in pinch strength by 11–31% are documented, with up to 71% of patients obtaining an increase in pinch strength (Hattori et al., 2014; Park et al., 2010; Wan et al., 2007). Restoration of palmar abduction of the thumb to 80% of the unaffected side is reported in around 90% of patients, with absolute improvements of between 9° and 22° (Foucher et al., 1991; Hattori et al., 2014; Kato et al., 2014; Park et al., 2010).

Only one study has directly compared the original Camitz procedure with a subsequent modification, in this case involving a pulley placed at the radial edge of the divided flexor retinaculum (Kato et al., 2014). This demonstrated improvement in side pinch strength, Disabilities of the Arm, Shoulder and Hand (DASH) score and Kapandji score in patients from both groups. However, the modified procedure was shown to be superior in restoring pulp pinch strength, palmar abduction and angle of pronation.

Improvement in overall hand function, by both subjective and objective means, has been reported in 86–100% of patients undergoing the original Camitz procedure (Foucher et al., 1991; Terrono et al., 1993; Wan et al., 2007; Yip et al., 2009). Two studies have shown peaks of recovery in function, strength and range of movement by 3 months, with little subsequent improvement thereafter (Hattori et al., 2014; Kato et al., 2014).

Discussion

All studies in this review were limited by small sample sizes. Overall, there is a lack of studies comparing the Camitz transfer with other opponensplasty techniques and studies comparing the various modifications of the original procedure.

The Camitz technique for opponensplasty has several advantages over other procedures. The palmaris longus tendon is easily accessible through the incision made for a standard OCTR (Kato et al., 2014; Ting and Weiland, 2002) and the PL can be sacrificed without concern about subsequent morbidity. The action of PL is synergistic with APB, meaning minimal rehabilitation is required postoperatively (Braun, 1978; Foucher et al., 1991; Kato et al., 2014; Naeem and Lahiri, 2013; Ting and Weiland, 2002). Biomechanical studies have demonstrated excellent abduction of the thumb with the Camitz transfer, although it must be noted that this is not the only movement involved in opposition (Lee et al., 2003). The procedure requires a relatively short operative time, can be done under regional anaesthetic as a day case, and minimal postoperative complications have been reported (Foucher et al., 1991; Kang et al., 2012).

The main drawback of the Camitz transfer is that, although it provides good abduction, it does not restore true opposition due to the radial axis of the transferred tendon, which is unable to provide pronation of the thumb (Braun, 1978; Foucher et al., 1991; Kato et al., 2014; Park et al., 2010). This results in poorer approximation of the thumb pulp to the head of the little finger metacarpal, when compared to other opponensplasty techniques (Lee at al., 2003).

Given the location of the incisions, the superficial palmar arch and the palmar cutaneous branch of the median nerve are at risk of iatrogenic injury (Baluch and Borschel, 2010; Park et al., 2010). If a pulley modification is used, there is potential for loosening over time due to widening of the pulley, and for the formation of tendinous adhesions at the contact points between pulley and tendon (Naeem and Lahiri, 2013; Park et al., 2010). Some authors describe reinforcement of the pulley with nylon sutures to avoid loosening (Park et al., 2010). Median nerve compression by the PL tendon has been reported in cases where ulnar pulleys are used (Naeem and Lahiri, 2013).

Lesser disadvantages of the procedure include prominent bowstringing of the transferred tendon, a lengthy recovery process, decreased range of extension at the MCPJ and unsuitability for patients with instability of the MCPJ of the thumb (Foucher et al., 1991; Hattori et al., 2014; Naeem and Lahiri, 2013). An obvious limitation is the necessity for the palmaris longus tendon to be present on the affected side. Sixteen percent of the general population are reported to have an absent PL on at least one side and 9% have bilateral absence (Naeem and Lahiri, 2013).

When using an opponensplasty concurrently with OCTR it is difficult to differentiate whether recovery is due to the tendon transfer or recovery of the median nerve after decompression (Hattori et al., 2014). This means that it is very difficult to counsel patients on the merits of opponensplasty, by any technique, when it is combined with OCTR.

As evidenced from the number of suggested modifications, there is also controversy over whether to use a pulley and, if so, where it should be placed. A study in cadavers has shown that maximal biomechanical efficiency in an opposition transfer is obtained by passing the tendon through Guyon's canal or the Royle-Thompson pulley (i.e. passing the tendon through the carpal canal and around the junction between the distal edge of the flexor retinaculum and the ulnar border of the palmar aponeurosis) (Lee at al., 2003).

Apart from its use in advanced CTS, the suitability of the Camitz transfer in patients with traumatic median nerve damage is unclear. Owing to the

superficial situation of the PL tendon, it is often unsuitable for transfer after previous injuries at the wrist, as it will probably be scarred itself (Naeem and Lahiri, 2013). However, good outcomes have been reported after using the Camitz transfer in acute injuries but only in a small series (Lin and Wei, 2000).

Finally, it is very difficult to accurately assess the functional outcome of Camitz transfer using the DASH and Carpal Tunnel Syndrome Instrument (CTSI) scores as these rely on sensory recovery as well as motor recovery. Improvement in these scores from sensory recovery after release of the carpal tunnel can therefore be easily perceived as overall functional improvement, regardless of the outcome of the tendon transfer.

Declaration of Conflicting Interests

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